December 6, 1944

NATIONAL PETROLEUM NEWS

TECHNOLOGY DEPT:

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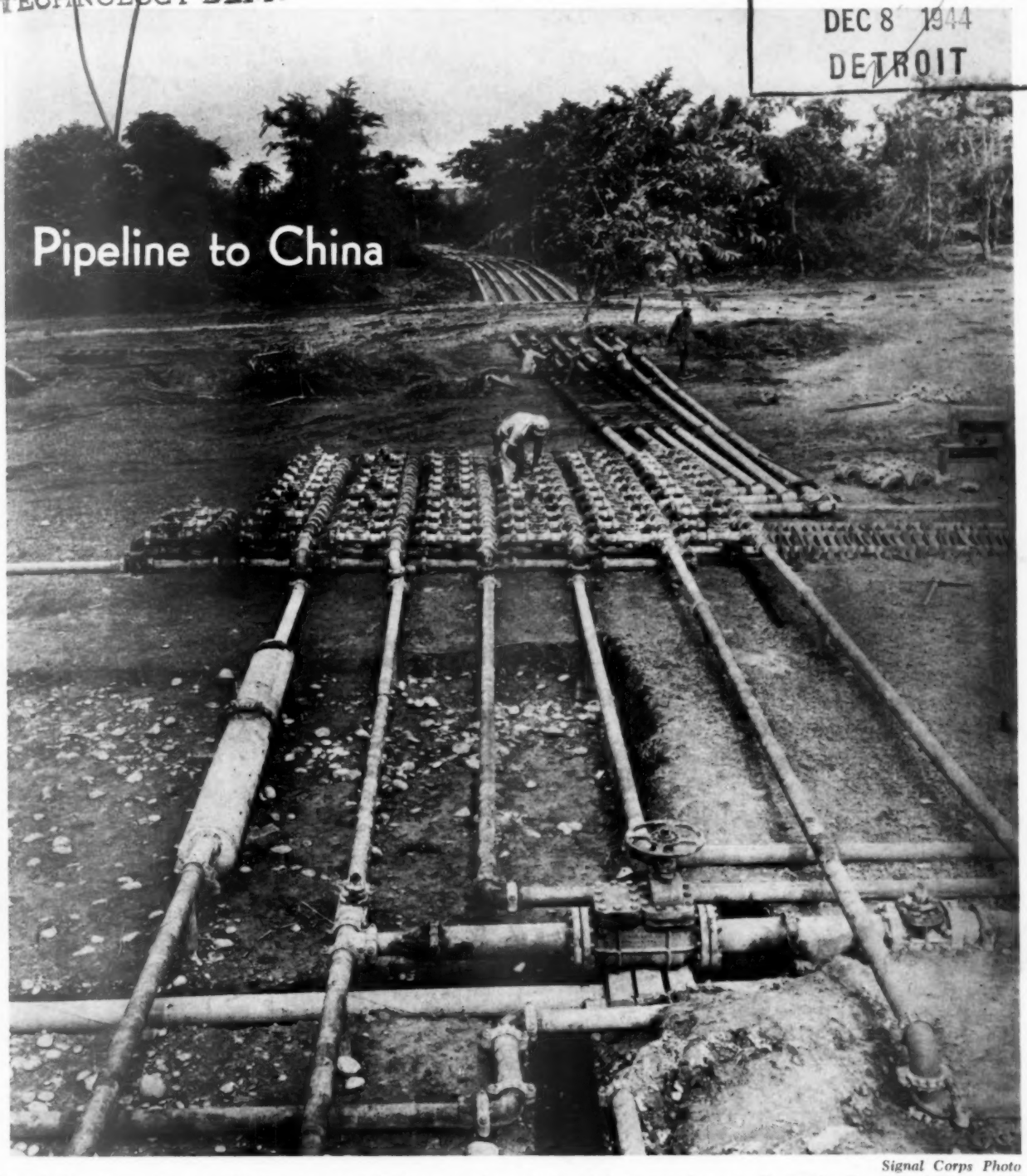
DETROIT

Pipeline to China



Signal Corps Photo

This photo shows the manifold valve installation on the India-Burma-China pipeline now being rushed to completion under direction of the 775th Engineer Petroleum Distribution Company. This section of the line, which ultimately will run about 2000 miles to American airfields in Yunan, China, is located "somewhere in Burma." The line begins at Calcutta and when completed will carry thousands of barrels of vital petroleum products to our forces in China, and will be the longest pipeline in the world. Units in Burma already are receiving supplies from the line

Highlights in This Week's NPN— **U. S. British Oil Treaty as drafted doomed . . . p. 3; Small Business Committee Assails OPA price policies . . . p. 3; Military and PAW Agree on Dist. 1 Shipping Schedules . . . p. 3; South Dakota Independents Draft Postwar program . . . p. 4; Southeastern Oil Co. joins DSC compensatory plan . . . p. 2; Seubert and Vandeveer honored for war services . . . p. 8; Oil men go to tractor school . . . p. 9.**

REFINERY MANAGEMENT AND PETROLEUM CHEMICAL TECHNOLOGY EDITION—In 2 Sections, Section 1

To the men and women
in the petroleum industry,

To our sons and daughters
who have left their homes
to take arms against
the enemy,
To our friends
and loyal workers,
To men of good will
everywhere,

Tokheim extends best wishes for

A Merry Christmas and a Happy New Year

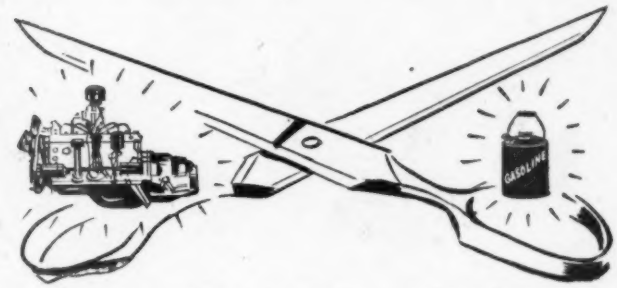
BUY AN EXTRA WAR BOND FOR CHRISTMAS!

TOKHEIM OIL TANK AND PUMP CO.
Designers and Builders of Superior Equipment
FORT WAYNE 1 For 44 Years INDIANA

Facts and Flashes

From the
ETHYL CORPORATION
Chrysler Building, N.Y.C.

Just what would you call half a pair of scissors? A "scizz"? Anyhow, one half isn't much good without the other—and this illustrates a situation that you may expect to find in the gasoline business shortly after the war.



The engine and its gasoline are as dependent on each other as the halves of a pair of scissors.

Today the public is being told that it is going to get super postwar gasolines. And there is no doubt that petroleum refiners will be in a position to furnish motorists with plenty of high-octane gasoline.

But high-octane gasoline all by itself cannot be expected to have a monkey-gland effect on John Q. Public's four- or five-year-old car.

Even though his engine may be in reasonably good shape, it wasn't designed to take full advantage of postwar fuels. But it will be possible to tune up his engine (paying particular attention to the spark setting) to get extra performance and mileage out of postwar gasoline.

Therefore, in talking to customers, it might be an excellent idea to start laying the foundation for a postwar tune-up job. A properly tuned engine will prevent disappointment, make car owners feel that the oil industry's claims for improved gasolines are justified.

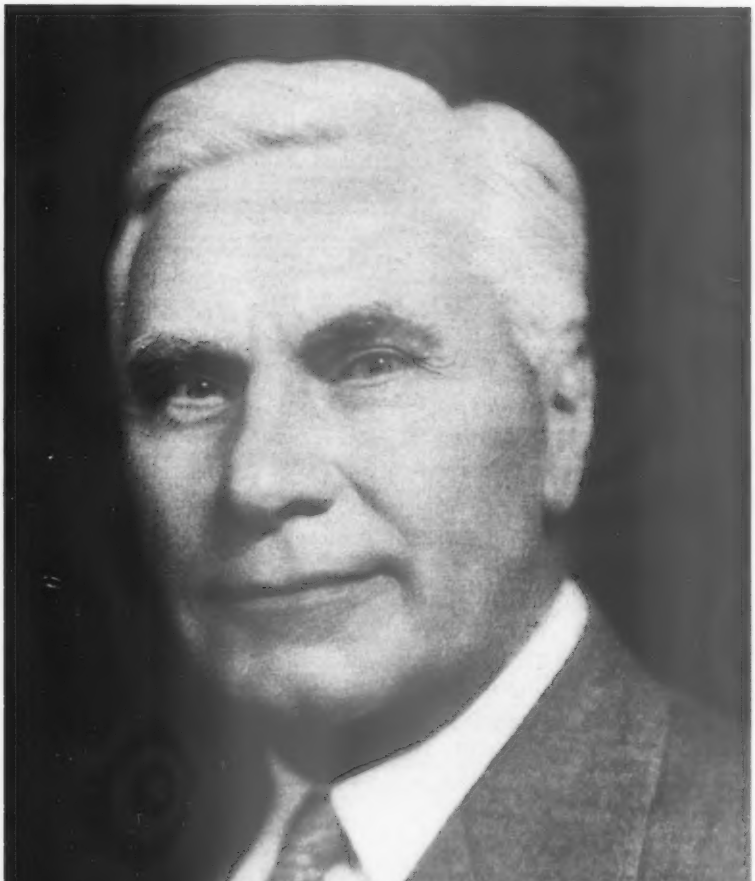
* * *

BUS PRODUCTION HAS BEEN RESUMED by one of the major companies in the field. The new city-type bus to be manufactured will have many improvements. Included are a new body to seat 41 passengers comfortably, an improved automatic transmission for smoother riding and greater safety, a new heating and ventilating system designed to improve passenger comfort. All these advances are being made in an effort to keep up the war-inspired trend on the part of the public to use buses.

NEW WRINKLE IN OIL TRANSPORTATION that eased wartime shipping problems was the use of double bottoms and fuel bunkers of ordinary dry-cargo ships. Prior to war, ships carried only enough fuel for scheduled voyages, with the balance of fuel-carrying space empty. Now at destination all oil in excess of return requirements is transferred to other ships or unloaded at a fueling depot. This plan released 128 tankers for other purposes.

Late Flash

PACIFIC WAR WILL be a bigger, more costly operation than most people realize. Long-range action over vast areas will require more of everything than the European invasion—more gasoline and oil, more planes, more amphibious tanks, more supply ships. That's why U. S. Treasury says 6th War Loan is most important of all. Digging into your pocket at home is a lot easier than digging into a foxhole.



Edward J. Bullock . . .

Succeeds Vandeveer as Dist. 2 Director

EDWARD J. BULLOCK of Chicago became PAW Dist. 2 Director-in-Charge on Dec. 1, succeeding W. W. Vandeveer, who resigned last week to return to private business as president of the Allied Oil Co., Cleveland, O.

It was with a keen sense of feeling for the boys who must fight this war on many battle fronts that Mr. Bullock came forward two years ago, offered his services on the home front and took up the vigil of oil and its facilities as his contribution toward victory. He was named PAW Dist. 2 Director of Facilities Security in September, 1942, where he has served quietly and with apparent efficiency since, but just what he and his corps of engineers did in that PAW division is one of the real military secrets that perhaps may never be fully revealed.

However, Mr. Bullock has the knowledge and experience for a thorough job in that capacity and in the new responsibility he has just assumed, for he has back of him nearly 50 years of activity in the oil industry, and on June 30, 1939, retired as vice president of Standard of Indiana in charge of purchases and as director of the Indiana company.

It is no exaggeration to say that Mr. Bullock literally grew up in the oil business, for as a boy, he secured a job as office boy for the P. C. Hanford Oil Co. in Milwaukee. He was so small he had to climb up on a box to answer the old wall telephone. That was in August, 1889, and he was filled with a determination to earn more than the $3 a week he was paid. He advanced to a clerical position in 1890, and two years later the P. C. Hanford Oil Co. was absorbed by the then new Standard Oil. Mr. Bullock became assistant manager of Standard's lubricating department in Chicago when 30 years old. In 1911, he moved over to the Atlantic Refining Co. as sales manager where he remained for about four years and returned to Standard as manager of the Chicago sales division, managed the purchasing of oils from 1919 to 1921 when he was named director of all purchases. He was elected a director in 1922 and a vice president in 1927. He retired the year Standard Oil celebrated its golden jubilee, 1939.

In announcing Mr. Bullock's new appointment, Petroleum Administrator Ickes said: "During the two years that he has served as PAW's Dist. 2 director of facilities security, Mr. Bullock has done an outstanding job. The fact that he has been associated with the Petroleum Administration for War, coupled with his long years of administrative experience as one of the leading oilmen in the Midwest, makes him an ideal choice as Director-in-Charge of the Dist. 2 office."

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BULLETINS

SOUTHEASTERN JOINS PLAN

WASHINGTON—The Southeastern Oil Co. made formal application to the Defense Supplies Corp. Dec. 5 for the right to participate in the Dist. 1 petroleum compensatory plan. A persistent holdout from the plan since its inception, Southeastern submitted with its request a detailed statement covering its sales and excess costs during the period from Aug. 1, 1943 through Oct. 31, 1944.

* * *

EATON REPLACES O'BRIAN

WASHINGTON — Resignation of John Lord O'Brian as general counsel of WPB was announced Dec. 5 by Chairman J. A. Krug. He is being succeeded by Frederick M. Eaton, of New York, who is presently solicitor of WPB and has been with government agencies since June, 1940. Laurence M. Lombard, of Boston, takes Mr. Eaton's place as solicitor.

* * *

DELAY GAS PRICE INCREASES

WASHINGTON—FPC announced suspension of proposed increased rates for natural gas sold by the Allegany Gas Co. and North Penn Gas Co., and set hearings for the two cases on Jan. 24 and Jan. 29, respectively.

Both OPA and the New York Public Service Commission had requested FPC to suspend Allegany's proposed rate schedules, it was disclosed, and OPA filed a similar petition concerning the North Penn Co.

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Anglo-U.S. Oil Pact Defunct; P.I.W.C. Gets Salvage Job

Total Demise as Now Drawn Made Certain as Connally Serves Notice That Approval Is Impossible, Unfair to Industry

NATIONAL PETROLEUM NEWS
NPN
NEWSMAGAZINE FOR OIL MANAGEMENT MEN

By Herbert Yocom
Chief, NPN News Bureau

WASHINGTON—Death of the Anglo-American Oil Treaty in its present form apparently was assured this week as the oil industry undertook, through P.I.W.C., to tell the Administration what it wants in the way of an international agreement, if there is to be one.

All speculation as to the probable fate of the present pact in the Senate seemed to have been ended by Chairman Connally, of the Senate Foreign Relations Committee, who in three short sentences, served blunt notice on the Administration that, as now written, it doesn't have a ghost of a chance of being approved, or even emerging from the Committee pigeonhole in which it has been reposing since last Aug. 24.

"The Anglo-American Oil Treaty now pending before the Committee on Foreign Relations," said Senator Connally, "will, in my opinion, never be ratified by the Committee."

"It is my view," he added, "that the treaty is unfair to the American oil industry and is not necessary for the general welfare. I have been opposed to ratification since it was first submitted to the Committee."

As Senator Connally spoke out, the P.I.W.C.'s Committee on National Oil Policy was already hard at work on a report which is supposed to present, in concrete form, the specific views of the industry as to the ingredients that should go into the making of any world agreement on oil. Members described the statement of the Senate foreign relations committee chairman as highly encouraging; said it probably assured careful consideration being given by the Administration to any recommendations that come from P.I.W.C. as a result of this week's council meeting.

Progress in the N.O.P.C. conference room was reported "good" at NPN presstime, but members refused to talk in other than general terms. Thus, the fate of a highly controversial proposed treaty revision drafted by Dr. Joseph Pogue and Judge Manley Hudson could not be definitely ascertained, although reports were that at least some members took the view that it was even more objectionable than the present form of the agreement.

Meantime, Deputy PAW Davies attempted to assuage the fears of P.I.W.C. and the industry generally by making available to members copies of an analysis of the agreement by PAW Chief Counsel Robert E. Hardwicke challenging the idea that its adoption would be a step in the direction of Federal control over oil.

Hardwicke Prepares Analysis

The analysis was prepared by Mr. Hardwicke, in private life an outstanding oil lawyer, in answer to two questions propounded by Mr. Davies, as follows:

"(a) What are the primary obligations assumed by the Government of the United States, particularly with respect to carrying out the approved recommendations of the International Petroleum Commission?

"(b) If the agreement should be approved by the Senate and become a treaty, will power reserved to the states be vested in the nation, and will Congress have power to legislate with respect to subject matter theretofore within the competence of the states in order to carry

(*Continued on p. 56*)

Committee Gets Green Light From Berge on Oil Talks

NPN News Bureau

WASHINGTON—Any doubts that oil policy committee members may have had as to the status of their deliberations regarding the Anglo-American oil treaty under the anti-trust laws apparently have been eliminated as a result of correspondence between PAW Chief Counsel Robert E. Hardwicke and Assistant Attorney Gen. Wendell Berge, head of the anti-trust division. Mr. Berge asserted "it is clear" that the group could meet and agree on recommendations for submission to P.I.W.C. without violating those laws.

Mr. Hardwicke had asked for an opinion as to "whether the reaching of an agreement by members of the council or its committee, the National Oil Policy Committee, upon specific recommendations to be made to the Petroleum Administrator for revision of the Anglo-American petroleum agreement, including a suggested re-draft of the agreement, would be considered a violation of the anti-trust laws."

Patman Group Assails OPA Price Policies

WASHINGTON—The House Committee on Small Business, in a unanimous report filed this week with the House, charged that OPA's current price policy is driving the independent oil producer out of business.

Pointing out the nation's need for increased exploration—"a normal function of the independent producer"—and that the present policy was failing to replenish war-depleted reserves, the committee said: "OPA refuses to make sufficient allowance in present crude oil price ceilings and premium payment procedures to encourage further exploration by the independents".

To offset these failures of OPA, the committee, chairmaned by Rep. Wright Patman of Texas, called upon that agency to make an immediate survey of finding, developing and operating costs in the crude oil producing industry. This and a similar survey of the refining industry, said the committee, should be undertaken and completed within 90 days.

"If the results of a survey show that the price of crude petroleum should be raised," the report added, "the price of petroleum products should not be raised to the consumer. Instead, if necessary, a subsidy should be granted the marginal-cost refiner whose profits might be

(*Continued on p. 12*)

Military and PAW Agree on Dist. 1 Shipments

WASHINGTON—PAW has reached an understanding with the military designed to prevent further diversion of overland transportation facilities and tankers from Dist. 1 to military use at least during December and January, provided unforeseen developments do not arise, NPN was informed Dec. 5.

Practical effect of the understanding is to freeze all present shipping schedules for the time being, with the military agreeing that if schedules have to be changed later they will try to lift by tanker from the Gulf Coast instead of taking over rail facilities.

On this basis, and assuming that it can hold tankers presently assigned to Dist. 1 service through the first quarter, PAW now figures, NPN was told, that it can "just skin by" this winter in supplying East Coast civilian requirements.

Meantime, while officials look for rail shipments to Dist. 1 for civilian use to commence increasing shortly, the task is being made difficult by the fact that the army, at the same time, is calling for conversion of more cars to sulfuric acid service. About 600 cars already are in process of conversion, and the army has just informed civilian agencies that it will require that many more.

This group was photographed in the Corn Palace at Mitchell, S. D., while waiting for call to order of the South Dakota Independent Oil Men's Assn. convention Nov. 28. (Left to right): H. C. Antonides, Brookings, retiring president; M. M. Hansen, Mitchell; George G. Scholl, Gregory; Jack Nickles, Yankton; Emmett Bauder, Huron; Herman Vanden Bosch, Gregory; H. J. Wolfe, Canton

South Dakota Independents Back Program for War and Postwar

Aggressive 14-Point Plan Adopted at Mitchell; Expanded Sales Sighted in New-Type Greases, Additive Oils and LPG.

By Earl Lamm
NPN Staff Writer

MITCHELL, S. D.—More than 200 oil men attending the 26th annual convention of the South Dakota Independent Oil Men's Assn. held at the Corn Palace here Nov. 27 and 28, adopted an aggressive program of 14 objectives for the coming year. From a profit slant, they heard speakers point out the importance of adding other petroleum products to their gasoline and oil sales, such as greases, additive-treated oils for heavy-duty service as soon as they become available, and liquefied petroleum gas.

The oil men were also warned to beware of government invitations to "save" them, and the suggestion was made that they stop asking for a continuation of government controls after X-Day to avoid getting more than they bargain for. They were urged to organize nationally on the same efficiently aggressive basis as the C.I.O. Political Action Committee and other strong blocs to protect their rights and the rights of all small business.

Objectives Listed

F. M. Hahn of Independent Oil Co. at Doland was elected president of the association, stepping up from the post of first vice-president, which he held during the past year. Fred E. Fankell of Rapid City also moved up a notch in the association's official family — from second vice-president to first vice-president. Leonard Wudel of Mitchell, filled the vacancy of second vice-president and Otto E. Jackson of Aberdeen was elected third vice-president. J. E. Adrian was reappointed executive secretary for the sixth year. Tom Devine, Pierre, was elected to the board of directors, replacing O. C. Hortman of Onida.

The list of objectives the association set for itself includes these important moves:

1. Endeavor to secure reduction of the state motor fuel tax from 4 cents to 3 cents.

2. Reduction of inspection fees.

3. Reduction of penalty for failure to pay motor fuel tax on due date to 5% for first 10 days and 10% thereafter.

4. Amendment of law on losses to give five days time for notification.

5. Attempt to secure uniform definition of motor fuel subject to state tax and uniform specifications for petroleum products.

6. Continue efforts for just and reasonable motor vehicle laws, licenses, fees, taxes, etc.

7. Earliest possible discontinuance of gasoline rationing after V-E Day, and discontinuance of fuel oil rationing in South Dakota at end of present heating season.

8. Early repeal of the Federal gasoline and lubricating oils taxes.

9. Amendment of Federal gasoline tax law to permit the exemption of tax on tractor fuels by certificate of dealer rather than certificate of customer.

10. Opposition to 6% freight rate increase as proposed to I. C. C. by the railroads, but if allowed, secure OPA approval to pass it on to consumers.

Secretary Adrian pointed out that the State Highway Commission now had on hand about $4,000,000 for highway construction, although very little work is likely to be done before end of the war. Meantime, other funds will accumulate, even if the gasoline tax is reduced from 4 cents to 3 cents per gallon. Dealers in the eastern section of the state he said suffered a loss now in competition with dealers in Iowa, which has a 3 cent tax.

State inspection fees cost the oil industry now about $100,000 annually, only a small fraction of which is required to cover the cost, Mr. Adrian said, and if cut in half would still be sufficient to pay for inspections and collection of the gasoline tax. Present penalty for failure to pay the gasoline tax on time is 10% for the first 10 days and 20% thereafter and it was felt that the surety bond operators must file guarantees payment of the amount due and the penalty should be less severe.

The convention was opened with an address of welcome by Mayor Dixon, and the association's retiring president, H. C. Antonides then brought his message. The members indicated their pleasure at his presence for since the meeting last year, he has been seriously ill.

Sees Jobs as Side Issue

He reminded the convention that there are 130 million people in this country and that each one has some sort of post-war plan. However, he said, economic studies have demonstrated that it is not the responsibility of industry to make jobs, but to produce more things in less time for less money. To follow any other procedure, he indicated, would bring a repetition of WPA and continued deficit financing. Jobs must be a side issue of industry's incentive to produce, he said.

Secretary Adrian in his report, briefly recounted the achievements of the association in increasing membership and the greater interest and activity of all members. As an addition to the list of objectives offered by the resolutions committee, he suggested that members hereafter make a consistent effort to increase their profits by promoting sales of lubricating oils and greases with every sale

of gasoline and tractor fuels.

"I visited with a jobber recently," he said, "and during the time I was there, 31 orders for motor fuels were received and the jobber said 'Thank you!' but he didn't ask a one of his customers if he needed lubricants or greases."

Increasing the sale of accessories and tires as they become available will add other profits, he said, and suggested that the possibility of handling bottled gas be investigated.

"In this sales work," he continued, "the education of your employes to be more courteous and thereby become better salesmen, is important."

Emphasis was also laid upon better bookkeeping, which Uncle Sam will require for tax purposes and coupons. Members were urged, as regards employes, to give consideration to matters beside the pay check, such as life and hospitalization insurance for workers, their families and for the jobber himself. Benefits, he said, were greater loyalty and less susceptibility to labor union propaganda.

Survey of Bulk Plants

A new survey is to be made of bulk plants, service stations, tank trucks and transports operating in the state as soon as questionnaires can be prepared and sent out in order to keep OPA, other governmental agencies and the state legislature informed of the strength of the industry in the state. A public relations program is to be started soon.

B. L. Majewski, chairman of the Dist. 2 distribution and marketing committee, addressed the convention on Monday afternoon. He gave support to PAW Ickes' recent statement that no easing of fuel oil rations is in sight because of military demand, and emphasized ODT's decision to restore the 200-mile minimum for tank car hauls, with no exemption for military use. With the burden again on trucks, he said higher priorities for tires were being sought and would be given.

Decision on ration banking for dealers is due from OPA by Dec. 15, Mr. Majewski said, in expressing hope that it would be adopted for dealers doing over 2500 gal. monthly. Big drawback, he said, has been inability to work out a satisfactory solution for overdrafts by dealers.

Stockpile of tetraethyl lead has reached the turning point, he continued, and improvement can be expected from here on.

The V-E Day outlook was given as a freer supply of products, with the oil industry urging orderly relaxation of rationing. Challenge in the coming battle of distribution, Mr. Majewski said, is to operate for peace needs as skillfully and as effectively as for war.

"Beware—well intentioned oil people—of government invitation to 'save' you," he warned. "Stop asking for a continuation of government controls for a brief period after X-Day. Stop asking for floors on prices as well as ceilings to the consumers. You will get more than you bargained for—but it will be *all bad*."

Mr. Majewski said he marveled at the efficient pre-election organizing job of the C.I.O. Political Action Committee and the indication of its permanence, and suggested that small business had the same right to organize. "To insure these rights," he said, "we must organize nationally on the same efficiently aggressive basis as the Political Action Committee and other strong blocs who carry weight in Congress and in local state governments."

U. S. Rubber Official Speaks

Harold L. Riggs, assistant district manager of United States Rubber Co., Minneapolis, substituting for F. S. Marceau, told the oil men that this year, synthetic rubber production should reach about 775,000 tons, which, added to 233,000 tons produced in 1943, gave a total of 1,008,000 tons although when former Price Administrator Leon Henderson, appeared before a Senate investigating committee in 1942 he declared that the production of 900,000 tons in the two years would be almost a miracle.

With the war continuing throughout this year, Mr. Riggs said, there was little hope of the tire industry attaining its goal of 22 million passenger car tires, and the average motorist is not likely to get new tires until sometime in 1945.

Heavy-duty truck and bus tire requirements for 1944 were placed at 19,300,000 for both military and essential civilian needs, with production reaching only 14,900,000—two million more than the industry has ever produced in any one year, but 4,400,000 short of demand.

Of the future of synthetic rubber, he said each additional day's experience in development and production brightened the outlook. The tremendous impetus given to research, he said, may result in the production of tires and other major products from synthetic rubber that equals natural rubber and sells at a competitive price. Inner tubes of Butyl synthetic now do a better job than natural rubber tubes, he asserted.

Experts Discuss Greases

Composition, manufacture and application of greases was discussed technically by M. L. Carter, chemist for Southwest Grease & Oil Co. of Wichita, Kans. The approaching new era in lubrication problems, he said, involves higher speeds, higher bearing pressures, new metallurgical composition in bearings and closer bearing clearances.

There are five main classes of greases, he continued, depending upon the kind of soap or base used in their manufacture: calcium soap greases made with lime for pressure guns, cups, axles; soda greases for ball and roller bearings; aluminum soap greases for chassis; additive or "all purpose" greases; and barium and lithium greases, in demand since development of war products.

J. H. Baird of Lubri-zol Sales Co., Cleveland, O., discussed additive-treated oils for heavy-duty service, illustrating his talk with picture slides of pistons and bearings showing the effects of use of various oils from heavy carbon deposits left by untreated oils to the apparently clean pistons where additive oils were used.

"The trend is toward greatly enlarged future use of additive oils," he said, explaining that at present military needs left little of such oils for civilian use, except for buses and trucks. He predicted that restrictions might be lifted by next spring so that they may be obtained for passenger car use. All future new automobiles will require additive oils, he said.

Three Discuss Liquid Gas

There were three speakers on liquefied petroleum gases, which products seemed to hold a great deal of interest as possible additional profit sources for the oil jobbers when they become more plentiful after the war's finish. Walter H. Hoagland of Fisher Governor Co., control equipment manufacturers of Marshalltown, Ia., described the gases as including pentane, butane, iso-butane and propane, and said the industry was composed of many large producer and marketing refiners and hundreds of independent operators, wholesalers and retailers.

It appears that at present few if any oil jobbers handle liquefied petroleum gas—bottled gas—for domestic or other uses although it is a fuel and most jobbers handle fuel oil and fuel oil burners. Sale of liquefied petroleum gas and the equipment in which it is used heretofore has largely been through hardware stores and similar retail outlets.

Mr. Hoagland analyzed figures from the 1940 census of the U. S. Department of Commerce to show market development and future possibilities.

Sale of liquefied petroleum gases, he said, increased 15% in 1943 over the previous year to a total of 675,000,000

Wiess and Roy B. Jones Win Service Awards

DALLAS, Tex.—Roy B. Jones of Wichita Falls and Harry C. Wiess of Houston will receive the "Distinguished Service Award" this year from the Texas Mid-Continent Oil and Gas Assn. according to the announcement of President Maston Nixon.

Mr. Wiess, president of the Humble Oil & Refining Co., began his career at the famed Spindle Top oil field at Beaumont. Mr. Jones, an independent operator, pioneered oil development in North Texas.

Mr. Nixon said that "this award is made annually to men who, over a period of years, have made outstanding contributions as citizens of the state, to the betterment of their home communities and to the petroleum industry and their own individual enterprises."

Plaques symbolic of the award will be presented to Mr. Jones and Mr. Wiess shortly in group meetings in Wichita Falls and Houston, Mr. Nixon said. The recipients are selected by a committee representing all branches of the industry. Sixteen men have been honored with this award in the last 10 years.

gals., of which 218,273,000 gals. was propane, 312,683,000 gals. butane-propane mixture and 4,155,000 gals. pentane.

H. H. Henley, president of Minngas Co. of Tracy, Minn. and Aberdeen, S. D., who has been distributing liquid gas for 7 years, told the oil men that he had put the gas in the hands of about 50,000 inexperienced people during that time and so far had not filed a single claim with his insurance company for accidental damage because of safety measures followed.

Harris A. Goodwin of the Bastian Blessing Co., Chicago, liquefied gas equipment manufacturers, gave a first-hand account of the recent big explosion and fire at Cleveland, O., as he happened to be there when it occurred. He said that the big spherical tanks that figured in that catastrophe did not contain L.P.-Gas but liquefied natural gas and that there was no connection between the two.

The convention banquet was held in Masonic Temple on Nov. 27, attended by more than 300, who were entertained by Don Klinger, magician from Aberdeen, and a string orchestra, the Yankton Hayshakers. Fred C. Christopherson, executive editor of the *Daily Argus-Leader*, Sioux Falls, made an address on his recent trip to England and France.

WPB Wins Oklahoma Permit For Carbon Black Plant

Special to NPN

OKLAHOMA CITY—Permit to build a $1,000,000 carbon black plant near Guymon, Okla., has been granted by Oklahoma Corporation Commission to Cabot Carbon Co., according to Conservation Officer Walker T. Pound. The plant, to be built with government funds, owned and controlled by DSC and leased to Cabot, will employ the channel process using sweet gas from the Guymon-Hugoton gas field. Capacity of plant will be 30,000,000 cu. ft. of gas per day. Permit was granted with stipulation that gas be paid for at rate of 5 cents per 1000 cu. ft., Mr. Pound said. And was issued only for the duration of the war and six months.

The order provides that Cabot purchase gas ratably and equitably from all wells or leases that can be reasonably reached by the company's pipelines.

Operators in the field opposed the plant which will use sweet gas in the channel process that recovers only one to two pounds of black per thousand feet while the chemical process recovers 10 to 11 pounds, commission spokesman said, adding that permit was issued after a telegram was received from WPB urging issuance.

WLB Sets Texaco Pay Hearing

BEAUMONT, TEX. — A public hearing has been scheduled here for Dec. 14 by the Eighth Regional War Labor Board in a dispute between the Texas Co. of Port Arthur and the Oil Workers International Union (C.I.O.). The dispute is over night premium pay.

Jersey Standard to Dissolve Hydrogenation Pool

Special to NPN

NEWARK, N. J.—Standard Oil Co. (N. J.) and 17 other participants in the hydrogenation patents pool were authorized by order of Federal District Court here yesterday to enter into termination and license agreements which, according to Attorney General Biddle in Washington, will establish a new basis for licensing.

The attorney general said that stockholders of Hydro Patents Co., who are the 18 members of the pool, have unanimously approved entry into the agreements, which will become effective upon acceptance and execution by all parties involved. The court order was entered in the case of U. S. vs. Standard Oil Co. (N. J.) et al.

In a statement announcing entry of the court order, Mr. Biddle said that conclusion of the new agreements would, in compliance with the anti-trust consent decree entered in the Standard case on March 25, 1942, assure the government substantial savings on its war purchases of aviation gasoline through royalty-free use of the hydrogenation patents during the war.

He added also that the agreements would lead (1) to the dissolution of Hydro Patents Co., as required by the 1942 consent decree, and (2) to the assumption by Standard Oil Development Co. and Standard Catalytic Co., of the functions of Hydro Patents Co. as licensor of the hydrogenation patents. The agreements are to be concluded by March 1, 1945, but the wartime saving of royalties is to be afforded retroactively.

Assistant Attorney General Wendell Berge, in charge of the anti-trust division, stated that the agreements, when concluded, would make available to industry several alternative types of licenses.

The department emphasized, however, that the court order does not in any way affect obligation of Standard of New Jersey under the 1942 decree to issue licenses under all of its hydrogenation patents as of that date, royalty free, for the duration of the war and six months thereafter and at reasonable royalties for the remaining life of the patents; nor does it in any way affect the issue of the ownership of the patents emanating from I. G. Farbenindustrie, now in litigation between Standard Oil Co. (N. J.) and the alien property custodian.

Stockholders of Hydro Patents, in addition to Standard, are:

Atlantic Refining Co., Barceo Oil Co., Cities Service Co., Continental Oil Co., Gulf Oil Corp., Mid-Continent Petroleum Corp., Pure Oil Co., Richfield Oil Corp., Shell Union Oil Corp., Sinclair Refining Co., Skelly Oil Co., Socony-Vacuum Oil Co., Inc., Standard Oil Co. (Indiana), Standard Oil Co. of California, Standard Oil Co. (Ohio), The Texas Co., and Union Oil Co. of California.

OPA Defends Coming Refusal of Sour Crude Boost

NPN News Bureau

WASHINGTON — A formal rejection of petition for a 17 cents per bbl. crude increase, filed by a number of West Texas and New Mexico producers last March and involving an output of about 500,000 b/d, was being prepared by OPA at NPN press time this week.

Senator Hatch (New Mexico), who got behind the producers' request, met recently with OPA officials, who enumerated reasons for denying the request.

Meantime the New Mexico producers involved have filed a separate petition with OPA, requesting a 10 cents per bbl. increase, which would make the ceiling price of their crude, amounting to about 100,000 b/d, comparable to that of Texas Panhandle crude.

In a letter to Senator Hatch on Nov. 25, OPA explained its reasons, saying in part:

"It has been argued that, since the maximum price of the Panhandle, Texas, field was increased, that a similar increase should apply to West Texas and South East New Mexico. . .

Differential Is Cited

"This office adjusted the maximum price of Panhandle crude on the theory, that because of its geographical proximity to Oklahoma crude oil, because the major portion of the crude was processed near the point of production and finally because the products refined from this crude oil are marketed in the Mid-Continent area, the Panhandle field should be regarded as being in the same general area with Oklahoma fields. The same reasoning is, of course, not applicable to West Texas and southeast New Mexico crude . . .

"On the basis of information sub-

Station Shut Down 30 Days For Picking Customers

NPN News Bureau

SACRAMENTO — OPA officials last week ordered Mrs. C. A. Monson, local service station operator, to close her station for 30 days following charges that she "discriminatorily refused to sell gasoline to a motorist".

This is the first case of its kind to come up in this area, the OPA said.

Testimony was presented to the effect that an automobile ran out of gasoline near the service station, and that when the driver tried to refill his tank "no gas was available". Immediately thereafter, the OPA said, two customers were sold gasoline at the station.

mitted to this office by refiners using both sweet and sour crudes, it appears that their extra costs of processing vary between 8 cents and 11 cents per barrel.

"While these considerations have been important, a very compelling factor in our thinking has been consideration of the effect such adjustment might have on the progress of the war. Full utilization of this crude has resulted in large part from subsidies by the government, which enabled it to be shipped by tank car to distant markets not otherwise open to producers in this area as, for example, Michigan, and the east and west coasts. Such assistance has not been required and has not been given other crudes.

"There is no evidence of hardship in this case, nor, as a matter of fact, is hardship alleged to exist by the petitioners. The price at which this crude was frozen in 1941 and which now is in effect, is, with the single exception of the initial posting of 1927, the highest in the history of the field."

Railway Assn. Joins Appeal For Better Tank Car Use

CHICAGO—The urgent necessity of speeding up repairs of bad-order tank cars and the importance of prompt disposal of empties to shorten turnaround has been called to attention of tank car owners by the Assn. of American Railroads. Circular letters to tank car owners dated Aug. 24, 1942 and June 14, 1944, have been reissued pertaining to inspections in loading and unloading areas and the method of handling repairs.

"It is imperative," said A. A. R., "that the tank car owners and railroads participating in the movement of petroleum products to both the Atlantic and Pacific seaboards do everything possible to keep tank cars in service. In some localities the railroads may be in position to assist car owners in reducing their bad-order tank cars."

In another letter of Dec. 1, A. A. R. said that, in view of the present critical tank car situation, attention was again called to the importance of prompt handling of tank cars held out of service awaiting orders of owners.

Additional Funds Requested By Gas Explosion Probers

CLEVELAND—The Board of Inquiry conducting an investigation of the East Ohio Gas Co. fire (*see NPN Oct. 25, p. 4*) last week asked for an additional $30,000, making a total of $50,000, to continue the investigation.

Only the first stage, that of finding what factors are involved and how they shall be studied, has been completed. Five technical experts are conducting the inquiry which started two days after the catastrophe.

Because of the magnitude of the work it is now estimated that the over-all time required for the studies will be approximately four months.

Maine Senator Nails Oil Pact 'Joker'

NPN News Bureau

WASHINGTON—Writing in the January *American Magazine*, Sen. Brewster, of Maine, asserts the reason for sidetracking of the Anglo-American Oil Agreement by the Senate Foreign Relations Committee was that it contains a "joker" which "could result only in the exclusion of American oil from (British) sterling areas." (*See NPN, Nov. 22, p. 8*).

"When this joker was discovered," he says, "the agreement was promptly pigeonholed by the committee, and at this writing is still there."

Mention of the oil treaty and other oil matters is included by the senator, a member of the Maloney Oil Policy Committee, in an article in which he urges: "Let's not be suckers again."

"We must stop being out-traded by our good friends, the British, the world's greatest experts in economic diplomacy," the senator says. On the oil angle, he writes:

"Our government's point of view regarding oil during the war has been incomprehensible. British oil reserves are about equal to ours, yet we have been furnishing about 80 per cent of the oil used by the United Nations, while the British have furnished about 8 per cent.

"One of the largest refineries in the world is a British development in Abadan, Iran (Persia), yet it was discovered about a year ago that this refinery was operating at only 60 per cent of its capacity, while half our tonnage was being used to transport oil across the Atlantic. We not only were shipping gasoline to North Africa, but we delivered so much that from Cairo to Algiers civilians went joy-riding to their hearts' content.

"The British, and our lend-lease officials, say that it has been easier and quicker to ship American oil to Africa and Great Britain. If that is true, then surely our diplomats should have demanded some concessions for American oil after the war to compensate for the depletion of our reserves.

"But the contrary is true. Last June an international conference was held to draw up a petroleum agreement, and one of Lord Beaverbrook's most startling proposals was that after the war the British would buy no American oil. His contention was that the British would not have the necessary American dollars and that it would create chaos in foreign exchange. The American representatives, it was understood, resisted such a plan and apparently agreed to no such embargo on American oil.

"However, when the agreement, as a treaty, went to the Senate Committee on Foreign Relations for approval it was discovered that it contained a joker. Hidden away in the minutes of the conference was a secret understanding that had been inserted, with the consent of American representatives, on the last day of the conference, which stated that foreign exchange was one of the economic factors to be taken into account in world trade in oil. Experts agreed that this apparently innocuous clause could result only in the exclusion of American oil from sterling areas. When this joker was discovered, the agreement was promptly pigeonholed by the committee, and at this writing is still there."

Flaming Well Tamed

Press Association Photo
NPN News Bureau

LOS ANGELES—Shooting a flaming column of oil 500 feet into the air, Standard of California's Huntington A-72 blew in Nov. 26, and for a time endangered a butane plant and scores of nearby wells. (*See photo above.*).

The well, located near Huntington Beach, caught fire with a roar, and the resulting blast jarred the beach city.

Workers had just pulled out the last section of drill pipe from the 5000 ft. deep hole when the blast of gas, rock and water let go. The well was brought under complete control three days later.

Lubri-Gas Working on Answer To Impending OPA Suit

CHICAGO — Lubri-Gas Laboratories were waiting early this week for formal notice of filing of OPA suit asking injunction restraining the firm from representing its product as improving the quality of regular gasoline to the point where a price premium could be charged. The OPA suit was filed Nov. 25, but as yet no summons has been served, according to Charles E. Paden, head of the firm. OPA said that failure to serve a summons was merely a delay in court service and no indication that the agency was dropping the matter.

In the meantime, a petition to be filed by the company with the Lea Committee and with the Senate Small Business Men's Committee was being worked up.

Seubert and Vandeveer Honored at Banquet for War Services

W. W. Vandeveer, who resigned as PAW Dist. 2 director-in-charge on Dec. 1, and E. G. Seubert, who retires as chairman of Dist. 2 Supply and Transportation Committee and treasurer of the Dist. 2 General Committee on Jan. 1, were honored at a banquet in the Blackstone hotel, Chicago, on Nov. 30. Here, upper photo left to right, are Paul G. Blazer, Mr. Vandeveer, O. D. Donnell, chairman of Dist. 2 General Committee, who tendered the banquet, Mr. Seubert, E. J. Bullock, who succeeds Mr. Vandeveer as PAW Dist. 2 director-in-charge, and B. S. Majewski, chairman, Dist. 2 distribution and marketing committee. Lower photo is a general view of the banquet scene with the guests standing in the rear

NPN News Bureau

CHICAGO—Two leading figures in the Midwest in Government-industry oil operations in support of the war effort announced their resignations last week.

They were W. W. Vandeveer, PAW Dist. 2 director-in-charge, who left that post on Dec. 1 after 17 months of service, and E. G. Seubert, who resigned as chairman of the Dist. 2 Supply and Transportation Committee and as treasurer of the Dist. 2 General Committee.

Mr. Seubert's resignation was submitted at a meeting of the General Committee on Nov. 30 and is to be effective on Jan. 1, 1945, when he also retires as president of Standard of Indiana. Mr. Vandeveer's resignation had been previously announced by Deputy PAW Davies in Washington.

Edward J. Bullock, former vice president and director of Standard of Indiana, who came out of retirement in September, 1942, to become PAW Dist. 2 director of facility security, has been appointed by PAW Ickes to succeed Mr. Vandeveer. (*See p.* 2). No announcement has yet been made as to who will head up the important Dist. 2 Supply and Transportation Committee and become treasurer of the General Committee; however, speculation points to the naming of either A. W. Peake, who succeeds Mr. Seubert as president of Standard of Indiana or Robert E. Wilson. On Jan. 1, Mr. Wilson comes to Chicago from New York as chairman of the board and chief executive officer of the Indiana company, a post which has been dormant for several years while Mr. Seubert exercised chief executive authority.

Following the General Committee meeting on Nov. 30, at which Mr. Seubert turned in his resignation, he joined Mr. Vandeveer as the recipient of tributes for jobs well done in war time oil service at a banquet in the Blackstone Hotel, tendered by O. D. Donnell, chairman of the General Committee, members of his committee and the staffs of PAW and Dist. 2 industries headquarters.

Mr. Vandeveer took charge of the PAW office here on July 15, 1943, and during his tenure, ran it with vigorous fairness that earned him the plaudits of the industry and the compliments of Deputy PAW Davies, who expressed regret at his leaving. He returns to industry as president of Allied Oil Co., Cleveland.

Mr. Seubert became a member of the General Committee of Dist. 2 at its inception and was chairman of the old Dist. 2 Transportation Committee from the beginning of the oil industry's participation in the war. Later the name was changed to Dist. 2 Supply and Transportation Committee.

Chicago Oil Men's Club Hears Plan for Milder Oil Pact

NPN News Bureau

CHICAGO—Replacement of the Anglo-American oil agreement with a plan suitable as a postwar international agreement, while guaranteeing the safety of the American petroleum industry, was advocated at luncheon meeting Nov. 30 of the Chicago Oil Men's Club. Charles Van Vleck, field manager of the Independent Petroleum Association of America, addressing oil men as the featured speaker, attacked the Anglo-American oil agreement as dangerous to the interests of domestic producers in that it could lead to federal control.

Phrasing of the agreement is not sufficiently specific, he held, giving as examples the expressions "with due consideration for known reserves" and "sound engineering practices", both of which, he said, were dangerously vague.

Mr. Van Vleck called attention to possible complications which might result from the agreement's reference to fair prices for all peaceable nations since the English viewpoint, as expressed in English publications, is critical of the high cost of American production in view of the anticipated large-volume low-cost production in the Middle East.

A compact modeled after the Interstate Oil Compact Commission was advanced as one possible way of handling the issues involved.

Treasury Offers 5- and 10-Gal. Cans in Surplus Goods Sale

NPN News Bureau

CLEVELAND—Issue No. 1 of the U. S. Treasury Department's Surplus Reporter lists several hundred surplus property items scheduled to go on sale on and after Dec. 15, 1944. Those interested should immediately contact the division of the regional office in which the property is located and request bid forms or additional information by numbers and names of items.

Of possible interest to oil men are approximately 3500 used 5 gal. and 10 gal. cans, with gauge varying from 18 to 28, item 3-2465-3; 81 battery charging generators, 30 volt - 5 amp. type 22806 - serial No. 1706, item 3-2184-3; 80 used ammeters, type NK 37 DC. Style DY 17378-1, 30 to 0-0 to 30, item 3,2184-3. The property is in Region No. 3, U. S. Treasury, Office of Surplus Property, 1126 21st St. N.W. Washington, D. C.

Oil Men Brush Up on Tractor Maintenance in Course at Illinois U.

Lubrication engineer students were required to dissemble, then re-assemble tractor parts at a school conducted by University of Illinois. Left to right, above, are Frank R. Hart, California Standard; L. W. Welch, Socony-Vacuum, Chicago; J. C. Stone, Standard of Kentucky; Frank A. Suess, Continental Oil Co., Ponca City, Okla.

Prof. R. I. Shaw, who was in charge of the short course in tractor operation and maintenance explains the dust collector bowl on a tractor air cleaner to (left to right) G. L. Service, Valvolene, Cincinnati; Harry Gillette, Standard Oil of Ohio, Cleveland; C. A. Stutzman, Sinclair, New York; and L. S. McLeod, Stewart-Warner, Chicago

Special to NPN

URBANA, ILL.—Thirty-two oil men from the engineering sales departments of large oil companies and one co-operative selling petroleum products to farmers attended the short course in tractor operation and maintenance conducted at the University of Illinois here all last week by R. I. Shawl, professor of farm machinery. The oil men came from 13 states and Toronto, Canada, to take the course. In addition there were six representatives from three tractor manufacturers present.

Prof. Shawl has been giving tractor short courses to farmers of this area since 1918, and the oil men decided they wanted to get in on the information after learning of its possibilities through Chek-Chart Corp., Chicago, sponsors of the school, who were represented here by E. L. Barringer.

The short course as given by Prof. Shawl and his laboratory technician, Fred Wiley, was a concentrated dose of tractor and farm machinery operation and maintenance. The "students" all practical oil men, went to the Agricultural Engineering Lab of the University at 8 each morning for a half-day of class room lectures, followed by a half day of "shirt sleeve" practical application of the basic information on Diesel and gasoline engines, both two and four cycle, studying pistons, rings, valves, bearings, carburetors, batteries, magnetos, the cooling systems, fuel and lubrication. Operation and maintenance of other farm implements such as tractor plows, combines and corn pickers was also included.

Each evening there were movies applicable to the subject under study, the films being supplied by Gulf, The Texas Co., Ethyl Corp., General Motors and the farm machinery manufacturers.

At a banquet on Thursday evening given by Chek-Chart, the oil men presented Prof. Shawl with a handsome watch. Dr. George L. Clark, professor of chemistry at the University, gave an illustrated lecture on the electron microscope.

A short course in tractor and farm equipment operation and maintenance given at the University of Illinois, Urbana, Ill., Nov. 27 to Dec. 1, was attended by this group of oil company lubricating engineers and representatives of tractor manufacturers. The school was conducted by Prof. R. I. Shawl, professor of farm machinery

It is anticipated that the lubrication engineers from the oil companies who attended the school, will apply basic information gathered here to instructing others in their own companies on how to assist farmers in servicing their farm machinery and equipment, and perhaps in establishing similar short courses at their own state universities.

Reveals Consolidation Details Of Nebraska-Indiana Merger

Special to NPN

OMAHA—Announcement of the consolidation on Dec. 1 of the Standard Oil Co. of Nebraska with Standard Oil Co. of Indiana was made on that date by H. W. Pierpont, president of the Nebraska company. He explained that Standard of Indiana had been sole owner of the Nebraska company and had operated it as a marketing subsidiary for some time and that, in order to simplify corporate setup, the Nebraska company would be liquidated and its properties and personnel joined with the Indiana company.

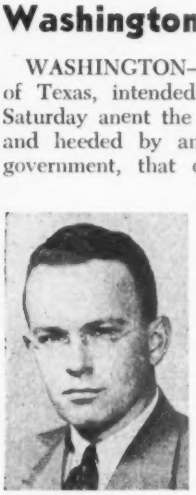
The Nebraska organization will become one of the sales units of Standard of Indiana's western division with headquarters in Omaha in the present offices and with the same staff with the exception of Mr. Pierpont, who will retire in accordance with plans announced some time ago. J. H. Hay, vice president of Standard of Nebraska has been appointed manager of the Omaha division. J. M. Terrell, now sales manager at Des Moines, will join the Omaha office as assistant manager. T. W. Hughes, treasurer of the Nebraska company, will continue as head of the accounting staff.

Mr. Pierpont's resignation as president closes 17 years spent with the company. He joined Standard of Nebraska in 1917 as purchasing agent, became secretary and director in 1919 and secretary-treasurer later the same year.

PIPELINES—*Views of the Industry's Problems*

Washington— *Connally's Remarks on Pact Aimed at Ickes* —By Herbert Yocom

WASHINGTON—If Senator Connally, of Texas, intended his remarks of last Saturday anent the oil treaty to be read and heeded by any one individual in government, that one individual could only be Secretary Ickes.



Mr. Yocom

This is true for the simple reason that Mr. Ickes, more than any one else in this Administration, has it in his power to say whether there shall, in fact, be an oil agreement that has the support of the American industry or, failing that, none at all. This Senator Connally seems to have recognized with his blunt notice that, in his opinion, the agreement *now pending* will never be approved by the Foreign Relations Committee.

As a matter of fact, by his own words, the idea of an agreement with the British is Secretary Ickes', and his alone. According to his recent article in *Collier's Magazine*, it was he who first broached the subject with the President and it was upon his urging primarily that negotiations were entered into with the United Kingdom. Having had the President's ear in the first instance, it would not seem unreasonable to expect, therefore, that a word from him now would be all that is necessary to persuade Mr. Roosevelt that a fresh start needs to be made.

This being so, the next move is clearly up to Mr. Ickes. Senator Connally has given him his cue, and P.I.W.C., if it does this week the honest job we believe it is bent on doing, will have shown him the way.

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The atmosphere concerning the scope and authority of the oil industry advisory committee under the anti-trust laws appears to have been clarified considerably as a result of the release for publication this week of an exchange of correspondence between PAW Chief Counsel Robert E. Hardwicke and Assistant Attorney General Wendell Berge, boss of the Justice Department's anti-trust division.

The correspondence includes a statement of conclusions expressed by Mr. Hardwicke to the P.I.W.C. at its Oct. 25 meeting, when members of the National Oil Policy Committee were worrying about their right to recommend specific revisions of the oil treaty or to make recommendations relating to subject matter outside the scope of the committee's authority.

Summed up by the PAW counsel in a letter dated Nov. 20, they have elicited no reply from Mr. Berge with the result that they are believed to coincide also with the viewpoint of the Justice Department. Mr. Hardwicke made three points, in all, as follows:

"1. Consultation with officials or agencies of the government, or the making of recommendations to such officials or agencies, does not constitute a violation of anti-trust laws, even though the suggestions or recommendations are specific and are adopted by the government. This is so, in the latter instance, because the suggestions and recommendations are made effective and operative by the government, not by force of individual agreement or combination. (The procedure provided for in Section 12 of the Small Business Mobilization Act would have to be followed in those instances where the facts make the section applicable).

"2. If, however, members of a group or a committee make recommendations to the government which are not adopted but, in spite of this, members of the committee, by agreement or concerted action, carry out the recommendations, then, if such acts by the participating individuals result in a violation of the anti-trust laws, it is not because of the mere making of the recommendations. It is because the recommendations, by individual agreement or combination, are carried out and made effective without the properly exercised authority or direction of the government.

"3. If a committee which is appointed by an official or agency of the government to consult with and make recommendations to the government exceeds its authority by making suggestions or recommendations with respect to subject matter not within the scope of its authority, there is no violation of the anti-trust laws merely because the committee exceeds its authority. As already pointed out, the mere making of suggestions or recommendations, no matter how definite or specific, do not constitute violation of the anti-trust laws, even though the government adopts the suggestions or recommendations."

Atlantic Coast— *Supply Situation Wrapped up in Defeat of Germany* —By Frank P. S. Glassey

NEW YORK—For several weeks this writer has been sounding off on the serious petroleum supply situation along the East Coast. It's never popular to be a pessimist and, as might have been expected, the warnings of possible acute shortage have brought some criticism. Well, the target is still open for snipers. The following paragraphs will contain some more unpleasant predictions.

Mr. Glassey

A week ago it was noted here that the shortage of gasoline for civilian use may become so grave that "A"-card rations might be cancelled. Now it looks as if "A," "B" and "C" coupons will retain their current nominal value, but in a few weeks their possessors will have to "shop" around for gasoline with little hope of obtaining the full amount to which they are entitled. In other words, we are facing an unprecedented shortage of motor fuel. Early in 1945, a good many pumps in Dist. 1 will be dry.

As the story is told here, the present crisis is largely due to miscalculation. Early in September most high Army and Navy officers were convinced that the war against Germany would be over by Nov. 1. Therefore they decided to give Gen. MacArthur and Admiral Nimitz the "go-ahead" six months earlier than had been originally planned. Then the offensive against Germany slowed down. The result is that we are now fighting two major wars at once, on a virtually all-out basis.

That does not mean, of course, that there is any danger of losing either war. It *does* mean that military demands for petroleum have skyrocketed and will continue at their present peak until one enemy or the other, probably Germany, is eliminated. While that condition exists the civilian will get only left-overs, and they will be extremely unsubstantial.

One of the first suggestions of military authorities was that "A"-cards be eliminated, and rations for "B" and "C"-card holders be reduced, while distribution of all fuel oil except distillate to civilian consumers be cut 20 per cent. Other proposals were that the Navy would take no more oil shipments to Europe from Gulf ports and that all tankers being used in the Gulf of Mexico be shifted to the Pacific since their shallow draft makes them ideal for island beaches. Furthermore, the Navy planned to put all other tankers on the Eastern seaboard into convoy duty.

If that schedule had been carried out, it would have left civilian consumers dependent on box car shipments in drums, on a very few tank cars and on the product from East Coast refineries obtained from crude carried through the Big Inch. Obviously this would have been insufficient even to operate the in-

dustrial plants supplying war products. At least 60 per cent of the entire U. S. industrial war output comes from the Atlantic Coast, most of it north of Virginia.

Representatives of PAW and of some of the larger oil companies also argued before military authorities that most of the workers in those war plants have to travel by private automobile and that to eliminate or cut rations severely would impose an impossible burden on bus transportation. It was also pointed out that most railroads have increased Diesel engine operation in recent years and hence need large supplies of Diesel oil.

So, within the last week, the military has relented — BUT slightly. It has agreed that the crude flow to eastern refineries must be maintained and so has consented to allow 40 of the oldest tankers in our fleet to continue to operate on the East Coast; also to permit one tanker daily to bring in refined products.

Some further hope is that additional tank cars may be requisitioned from manufacturers of molasses, vegetable oils, wines and similar products. Meanwhile, the DSC has approved compensation for box-car shipments, preliminary surveys indicate there are enough drums on hand, and there is hope that box cars can be rounded up.

Practically all box-car shipments will go to New England, which has been hardest hit. Probably No. 2 fuel oil, as well as kerosine, will be carried in drums before the winter is over. Heavy oil should continue to arrive in adequate amounts, chiefly because of the necessity of keeping Maracaibo refineries operating at capacity.

But the outlook for the small user of fuel oil and for the civilian consumer of gasoline is grave. And the only possible break in the clouds, it appears now, is a quick victory over the Nazis.

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The goal of having every primary supplier in Dist. 1 in the DSC pool seems nearer realization. Gordon Duke, president of Southeastern Oil Co., has offered to pay $45,000 to the DSC as a settlement that would result in Southeastern's inclusion in the pool. The offer is based on the computation of $72,000 due DSC above the extra cost of transporting petroleum products from Mexico, with a deduction of $27,000 representing transport of domestic petroleum products.

Mr. Duke seems optimistic, following protracted discussions here and in Washington.

"We hope we will be able to reconcile the situation to the satisfaction of PAW," he said this week. "My impression is that the negotiations now being carried on will result satisfactorily."

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P.S.: A final warning note, just in case there's doubt in any minds: There will be a severe shortage of gasoline and fuel oil on the East Coast this winter.

Midwest— *Co-ops and Taxes; Court Decision Bolsters Need for Equalization* —By Earl Lamm

CHICAGO—The income tax exempt co-operatives have been making much ado in their publications about the recent decision of the U. S. Tax Court, sitting at Indianapolis, Ind., on Sept. 29, wherein the commissioner of internal revenue endeavored to collect taxes on the income of United Co-operatives, Inc., of Alliance, Ohio, for the years 1937-38-39.

Mr. Lamm

The court decision favored the co-ops on patronage dividends. However, when carefully examined, the case is not as glaring as the co-ops would have the public believe. The co-op press headlines called the decision a slap at the National Tax Equality Assn. and others who seek equalization of the heavy tax burden in order that all business may share alike in financing the winning of the war.

In the first place, let it be understood that NPN has never contended that the co-ops were acting illegally in avoiding an equal share of the tax burden. In fact, in the May 3, 1944, issue of NPN, page 18, we quoted verbatim parts of Sec. 101 of Bureau of Internal Revenue Income Tax Regular 111, on which the co-ops base their legal tax exemption. In all the literature and personal contacts we have had with the National Tax Equality Assn., that association has followed a similar procedure.

Therefore, pursuing the matter of tax equalization is not a question of catching criminals, but one of securing revisions of the law to equalize tax assessments.

In stating its position, N. T. E. A. said: "The whole feeling is that no court decision will tax co-ops as they now stand, because the law is set up either to exempt them or to allow those not exempt to exclude patronage dividends from taxable income. Their action in not paying an equal share of taxes is therefore legal tax avoidance, which enables them to pyramid themselves rapidly in competition with other heavily tax-burdened enterprises."

As for the United Co-operative, Inc., case, that co-op was not organized under co-op laws until 1941, according to N.T.E.A. The Commissioner of Internal Revenue contended that the patronage dividends of the co-op for 1937, $122,461.29; 1938, $90,622.30 and 1939, $154,921.28, or a total of $368,004.87, were includable in its taxable income.

The court held that patronage dividends were not taxable since the corporation operated as a co-op. The court did, however, rule that patronage dividends could not include amounts required by the co-op's by-laws to be paid as dividends on common stock. This amount, as stated in the co-op's by-laws, was up to 8% of the par value of outstanding common stock. Thus, the court held that this 8% was taxable, which action the co-op apparently felt would take place for it changed its organizational set-up in order to get on a full co-op law basis in 1941.

Hence, the court decision merely strengthens the contention that income tax laws should be revised in order to secure equalization of taxation.

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While the democratic process of securing a revision in tax laws goes ahead, the federal income tax exempt co-op boom continues. At the 16th annual meeting of the Consumers Co-operative Assn. in Kansas City last month, the proposed International Co-operative Trading & Manufacturing Assn. was given financial backing by approval of the investment of $150,000 by C. C. A.'s refinery subsidiary, Co-operative Refinery Assn., owners of the oil refinery at Coffeyville purchased from National Refining Co.

Tax position of the co-operatives was stated in a resolution passed at the Co-op Centennial held in Chicago Oct. 8-13: "We believe that all taxation should be based strictly upon the needs of the people to serve themselves adequately through their government. Furthermore, we believe that ability to pay should be the basis of any tax program and that it be reflected in adequate and equitably-graduated income taxes, supplemented, if necessary, by selected sales taxes on so-called luxuries and other non-essentials; upon commercial amusements and upon gifts, inheritances and intangibles.

"We oppose general retail sales taxes, poll and payroll taxes and other forms that place an unjust or inequitable penalty upon the necessity to use or to consume."

That summation of the situation left us wondering what all the tax fuss was about until later the co-op press clarified the resolution by an addition to make the second sentence read: ". . . . . reflected in adequate and equitably graduated income taxes *on individuals* . . . . ." In other words, the co-op tax policy remains the same—a single tax system, doing away with all corporation taxes and leaving the federal government to rely almost exclusively upon taxes from individuals.

OPA Oil Pricing Ruins Independent Producers, Patman Committee Says; Calls for Cost Survey

(*Continued from p. 3*)

adversely affected by an increase in the price of crude oil."

Despite OPA's failure in the past to initiate new cost studies of crude oil production, the committee said there was definite need for such a survey now, to show present operating costs of the independent oil producers.

"This study should be based upon attested figures submitted to OPA upon a uniform cost form," the report recommended. "Due to the great number of firms engaged in crude oil production, the study should not attempt to include reports from all firms in the industry. Instead, the same procedure should be used as in the recent study of costs in the southern pine lumber industry wherein a limited number of firms were selected by mutual agreement between OPA and representatives of the industry. In that instance, uniform cost forms were sent to approximately one hundred firms whose operating costs were believed to be typical of the entire industry."

Pointing to the fact that OPA is not inclined at present to segregate the costs of low-cost flush-well producers from the costs of the more expensive stripper well operators in their over-all consideration of the "alleged unfairness of the national level of crude petroleum prices," the report stated:

"When it is considered that the bulk of the low-cost flush-well operations are owned by the major, integrated companies with the independents' interest being largely confined to the higher cost wells, it is apparent that any survey which is made should take this fact into account and should segregate the findings to that extent."

Text of Recommendations

Complete text of the committee's recommendations, based on these conclusions, follows:

"1. OPA should immediately appoint an industry advisory committee to represent the crude petroleum producers. This committee should be appointed on a nation-wide basis and the independent producers should be given representation proportionate with their percentage of national production and the number of firms engaged in that business.

"2. OPA should immediately initiate a study of the finding, developing and operating costs of the crude oil producing industry in accordance with the recommendations listed in the . . . conclusions (as summarized above).

"3. OPA should immediately initiate a study of the operating costs of the refiners.

"4. OPA should take greater cognizance of the role of the independent and other producers in the field of exploration and should include amortization of exploration costs as part of the permissible costs used as a basis for calculating price ceilings on crude oil.

"5. Because of the impracticability, from a marketing standpoint, of granting price increases to individual producers in a given pool at a time when other producers retain lower ceilings, OPA, upon the conclusion of the proposed cost studies, should grant such over-all increases in the price of crude petroleum on a nation-wide basis as will permit all producers whose operations are conducted in a normal and efficient manner to make a fair profit on their production operations.

"6. A premium price plan for stripper wells should be maintained if such an increase in the over-all price is put into effect in order to prevent abandonment of these stripper wells whose costs still remain too high, and, also, to continue the flow of their product into essential war and civilian uses.

Proposes Subsidy to Refiners

"7. In order to avoid the necessity of increasing the price of any petroleum product to the consumer, OPA should grant a subsidy to marginal-cost refiners whose profits might be adversely affected by any further increase in the ceiling price of crude petroleum.

"8. The independent producers, through their duly accredited individual representatives, should render full cooperation to the Office of Price Administration in accordance with the rules and regulations of that agency, in the furtherance of the above suggested program.

"9. A time limit of 90 days from date should be set as the maximum period required by the Office of Price Administration to conclude the suggested cost studies. It is assumed that the industry will continue to show its willingness to cooperate in these matters of fact finding."

PAW Cites Figures on Tight East Coast Oil

NPN News Bureau

WASHINGTON — Continuation of a serious supply situation along the East Coast was pointed up this week by a statement of Deputy PAW Davies that PAW had been informed by the military "that there is likely to be no decrease in the (military) demand for petroleum products until some time after V-E (Victory in Europe) day."

An East Coast supply bulletin quoted Mr. Davies as saying that "the emergency situation will probably continue throughout the 1944-45 heating season," and contained a further statement by PAW Ickes that "a severe drain on civilian supplies would result if military requirements for overland transportation continued at present high levels."

Military demand for oil in Dist. 1 now is about 500,000 b/d higher than at the same time a year ago, according to PAW.

PAW placed total stocks of civilian-grade motor gasoline held at refineries and terminals in the U. S. at 39,440,000 barrels on Nov. 18, up 519,000 barrels over the previous week. This is the largest increase in civilian stocks since the week ending April 1, 1944, but PAW said this merely indicated the end of the fair weather motoring season and the beginning of the buildup for heavy farm demands next spring.

Despite the nation-wide increase, civilian gasoline stocks in Dist. 1 and in Dist. 3 declined 210,000 and 197,000 barrels, respectively, during the week.

Big Inch pumped an average of 306,692 b/d for the week ended Nov. 24, compared with an average of 309,365 b/d for the previous week, while Little Big Inch pumped an average of 226,234 b/d compared with 215,503 b/d the previous week.

Crude and civilian product stock figures by individual districts for the latest date follow:

	Gasoline	Kerosine	Distillate	Residual	Crude
	(Figures in Thousands of Bbls.)				
DIST. 1					
Nov. 18	7,447	6,592	15,139	10,738	16,913
Nov. 11	7,657	6,637	15,541	11,276	16,990
DIST. 2					
Nov. 18	16,780	3,405	9,822	5,611	71,810
Nov. 11	16,560	3,478	9,735	5,808	72,230
DIST. 3					
Nov. 18	9,892	3,570	11,012	10,595	105,410
Nov. 11	10,089	3,489	11,047	10,839	105,646
DIST. 4					
Nov. 18	1,127	105	386	604	6,817
Nov. 11	1,077	105	389	626	6,859
DIST. 5					
Nov. 18	4,194	465	11,658	29,096	27,138
Nov. 11	3,538	461	11,547	28,878	27,314

Manpower Shortage Critical, Somervell Warns; Aviation Fuel Plants Short 6000 Workers

NPN News Bureau

WASHINGTON—Lieut. Gen. Brehon Somervell said this week that a shortage of 311,479 war workers in war plants imperilled vital production of tires, trucks, ammunition, and artillery, and declared that "the problem must be licked within a month."

Gen. Somervell did not mention the oil industry, but in other quarters it was learned that there is currently a shortage of six to eight thousand skilled and unskilled workers in refineries producing 100-octane and other vital petroleum products. Production of aviation gasoline is being lost at a "very serious rate," according to an authoritative source, who pointed out that specific figures could not be released for security reasons. Manpower shortages were described as acute along the Gulf Coast, and in the Chicago, Philadelphia and West Coast refining areas.

Million Leave Jobs in Year

Requirements for new "superfuel" coincident with demands for 130 Grade aviation gasoline, have resulted in a condition described as critical as that which the industry faced early in 1942 when the 100-octane construction program got underway. The urgent need for speed in construction forced use of materials which were sub-standard in many cases. Tremendous increases in maintenance requirements have resulted and while materials have been available, manpower has not been.

Testifying before the Senate War Investigating Committee, Gen. Somervell said that if the manpower needs were not met within a month, he might have to ask Congress to pass a national service act to conscript the necessary workers. A million war workers left their jobs within the past year, many of them to enter the armed forces, he added, and it was the present task of WMC, WPB, and the Army Service Forces—co-ordinating their efforts—to provide maximum war production.

The tire industry ranks high among critical programs in which stepped-up production is needed, Gen. Somervell said, pointing out that he planned to confer that day with Sherman Dalrymple, president of the United Rubber Workers (CIO) and later with rubber-industry management "to find out why production goals are not being met."

Steps which the general suggested in order to induce more workers to take war jobs were as follows:

(1) Adoption of a bonus plan, such as had previously been suggested by WPB Chief Krug. Under this plan, a worker staying on his job throughout the war period would be rewarded for his efforts after V-J Day (victory over Japan).

(2) Transferring workers from civilian production to war production within war plants;

(3) Adoption of the so-called "Utah Plan" which means putting a "ceiling over civilian production" and transferring workers released from non-war production to war plants; and

(4) Cancellation of "spot authorizations." This proposal was adopted last week as WPB's interim reconversion program was virtually suspended for a 90-day period, following objections from the Army and Navy that it was curtailing current efforts to produce munitions needed by Gen. Eisenhower's drive on Germany.

68 Areas Affected

Reasons for suspending the "spot authorization" were detailed in a letter from WPB Chairman Krug, WMC Chairman McNutt, Navy Secretary Forrestal, and War Undersecretary Patterson to their field representatives. It stated that no "spot authorizations" are to be issued, "except in unusual cases," in 68 Group 1 labor shortage areas and 44 other areas where war production is lagging. Additional areas may be placed on this list by WPB and WMC.

Spot authorizations may be made in other areas only if war production is on schedule and if there is available a supply of manpower which is not usable in war production in the area or for interregional recruitment elsewhere.

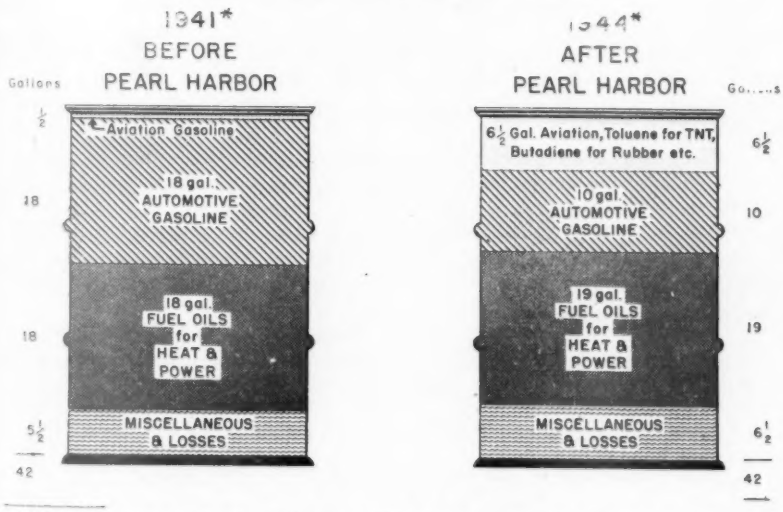
New Ruling Explained

"Reconversion to, or expansion of, less urgent production, or preparatory steps in connection therewith, that require the type of labor currently needed in war production must not be authorized," the letter asserted.

"Plants engaged in production on programs or products on the National Production Urgency List, or plants designated as of equal urgency by the Area Production Urgency Committees, must be continuously scrutinized from the viewpoint that, even though they are on schedule, increased quantities of their products may be needed to satisfy total requirements. Continuous effort must be made to increase the output of the products of such plants to the maximum. For example, in certain instances by agreement between WMC, WPB, the affected procurement agencies and management, needed labor for 'must' production can be provided by a transfer of workers engaged on less urgent work in such plants . . .

"In view of the extremely heavy manpower demands for urgent war production, it is not possible at this time to grant any blanket exemption from these policies to smaller plants. Applications from such plants however, should be given particularly prompt consideration."

Petroleum Products at War



*1941 figures are for the entire year; 1944 figures are for the month of August.

Chart Prepared by PAW

Civilians have LESS because MORE has gone to war

NPN News Bureau

WASHINGTON—Military oil requirements for United Nations use have reduced the yield of civilian automotive gasoline from a single barrel of crude oil by more than 44%, PAW estimated this week.

A 42-gal. barrel of crude yields only 10 gals. of automotive gasoline where formerly 18 gals. were obtained, PAW Ickes said.

Where a barrel of crude oil formerly yielded 0.50 gal. of all grades of aviation gasoline, he reported that it now yields six and one half gallons; also, that 19 gals. of fuel oil are obtained instead of 18 as in 1941.

PAW Forecasts Increasing Difficulties in Materials: Some Factors Better, but Drilling Rigs Increase

NPN News Bureau

WASHINGTON—PAW Materials Director Parsons this week reported to P.I.W.C. that the unprecedented number of drilling rigs now in operation, combined with those yet to be started, will cause an increasing number of problems in obtaining materials.

The great number of new rigs, he said, is causing an abnormal demand for repair parts and replacements, adding that this, plus a misunderstanding on the part of many operators as to when to use AA-1 or AA2X ratings, had further unbalanced supply.

"In order to eliminate this part of the problem," the materials director explained, "we have decided to require countersignature of our district offices on purchase orders carrying an AA-1 rating for complete parts or units of rigs, such as casing hooks, blocks, draw-works, pumps, etc., needed for replacement. However, an automatic AA-1 rating, without countersignature, will continue for repair parts to be used in repairing complete parts or units which have been in operation on an existing rig. Complete new rigs, or new complete parts or units to be used to rehabilitate old rigs which have not been in operation, will carry an automatic AA-2X rating without countersignature.

"We have also taken steps to correct dislocations on present schedules of manufacturers, so that existing rigs will have their proper place therein."

Other Highlights

Other highlights from the monthly materials report were . . .

1. Demands on manufacturers will be further amplified in 1945 by expanding foreign petroleum programs.

2. The only item which has become more critical in recent weeks is tires for heavy-duty trucks. Oil industry has a top civilian priority for tires, "but tremendous military demands and manufacturing shortages are playing havoc."

3. Drilling engine deliveries improved during October, when 232 engines of more than 500 cu. in. displacement were delivered, the largest number during any month of the war.

4. October tool joint production was 34,521 as compared with 29,675 in August, 27,388 in June and 25,107 in April. Production is being steadily increased as new machinery arrives.

5. There is more drill pipe being produced than is being worn out and the situation will ease considerably when rate of starting new rigs begins to slow up.

PAW Production Director McWilliams reported to P.I.W.C. this week.

Other highlights from the report:

1. It is doubtful that crude stocks can be reduced much below actual current levels without adversely affecting refinery operations.

2. Officials of PAW and WPB have consulted on procedure to be followed by industry in obtaining priority assistance for acquiring materials after V-E Day. It was tentatively agreed that the program contemplated by the PAW production division, which involves revising P-98-B to provide extendable priority ratings for acquisition of materials to be used in conformance with PAO-11, "appears feasible and desirable."

3. WPB has allotted 288,000 tons of carbon steel and 51,000 tons of alloy steel for oil production operations for the first quarter of 1945, which meet requests of PAW.

4. Studies are being continued concerning relaxation of spacing rules for western Kansas fields.

5. In connection with PAW's many recommendations to the California State Lands Commission regarding step-up in testing and development under tidelands off the coast of that state, commission recently called for bids on tideland leases between Huntington Beach and the Los Angeles county line.

6. There were 329 exploratory completions made during October, Texas accounting for 117, Kansas 39, Illinois 26, and Oklahoma 25.

7. Fourteen states reported total of 62 discoveries in October.

8. Total wells drilling as of Nov. 1 amounted to 3748, an increase of 6.5% over the corresponding time in the peak development year of 1941. Total well completions for the first ten months of 1944 were considerably below the completion rate for the same period in 1941 but exceeded those of 1942 and 1943.

PAW Yields to War Necessity; Gives Up Tube Goods Boost

WASHINGTON—Because of urgent military demands, WPB has tabled a PAW recommendation that mill stocks of oil country tubular goods be expanded from 20,000 to 115,000 tons,

Dealers Given Extension On 'Balance' Statements

NPN News Bureau

WASHINGTON — Fuel oil dealers with registered storage capacity of 1000 or more gallons will have until Dec. 31 to file first of their semi-annual "balance" statements, instead of Oct. 25, as originally required, OPA announced today.

OPA emphasized that Dec. 31 will be the "final" date for filing the first statement. All statements must be filed on or before that date with local rationing board with which dealer is registered. Any dealers who do not file by then "will be subject to enforcement action," OPA added.

It was originally provided that the statements were to give complete information as to ration evidences and ration bank balances in relation to each dealer's supply of fuel oil as of Oct. 1. Since it may be difficult for dealers who have not filed to make out their statements as of that date, today's action provides that the statements may be as of Oct. 1 or as of Dec. 16, whichever reporting date is more convenient for the dealer.

Time extension is being granted, OPA said, because a number of dealers did not receive notice of the October requirement sufficiently in advance, or were unable to get the necessary copies of the reporting form. The form to be used is OPA Form R-1198, and copies are obtainable at OPA district offices.

It was further explained that the semi-annual statements will provide a regular method of checking ration evidences against dealers' inventories of fuel oil. The second of these semi-annual reports will be due not later than April 25, 1945.

The forthcoming action will not affect fuel oil dealers who have a registered storage capacity of 250 to 999 gallons.

Disposal Plans Incomplete On Big and Little Inch

NPN News Bureau

WASHINGTON—Detailed engineering studies which will be used in connection with future disposal plans have been completed by Defense Plant Corp. on all but nine of the 1000 government-owned war plants and facilities, according to DPC Executive Vice President Hans A. Klagsbrunn.

Mr. Klagsbrunn testified to this effect this week before the Senate War Investigating Committee and later told NPN that among the nine for which studies have not been completed are the big and little Big Inch pipelines and the Plantation pipeline extension between Greensboro, N. C., and Richmond, Va. He said "complicated right-of-way and other questions" made for slow progress.

Ickes and Davies Praise Brown at Departure

NPN News Bureau

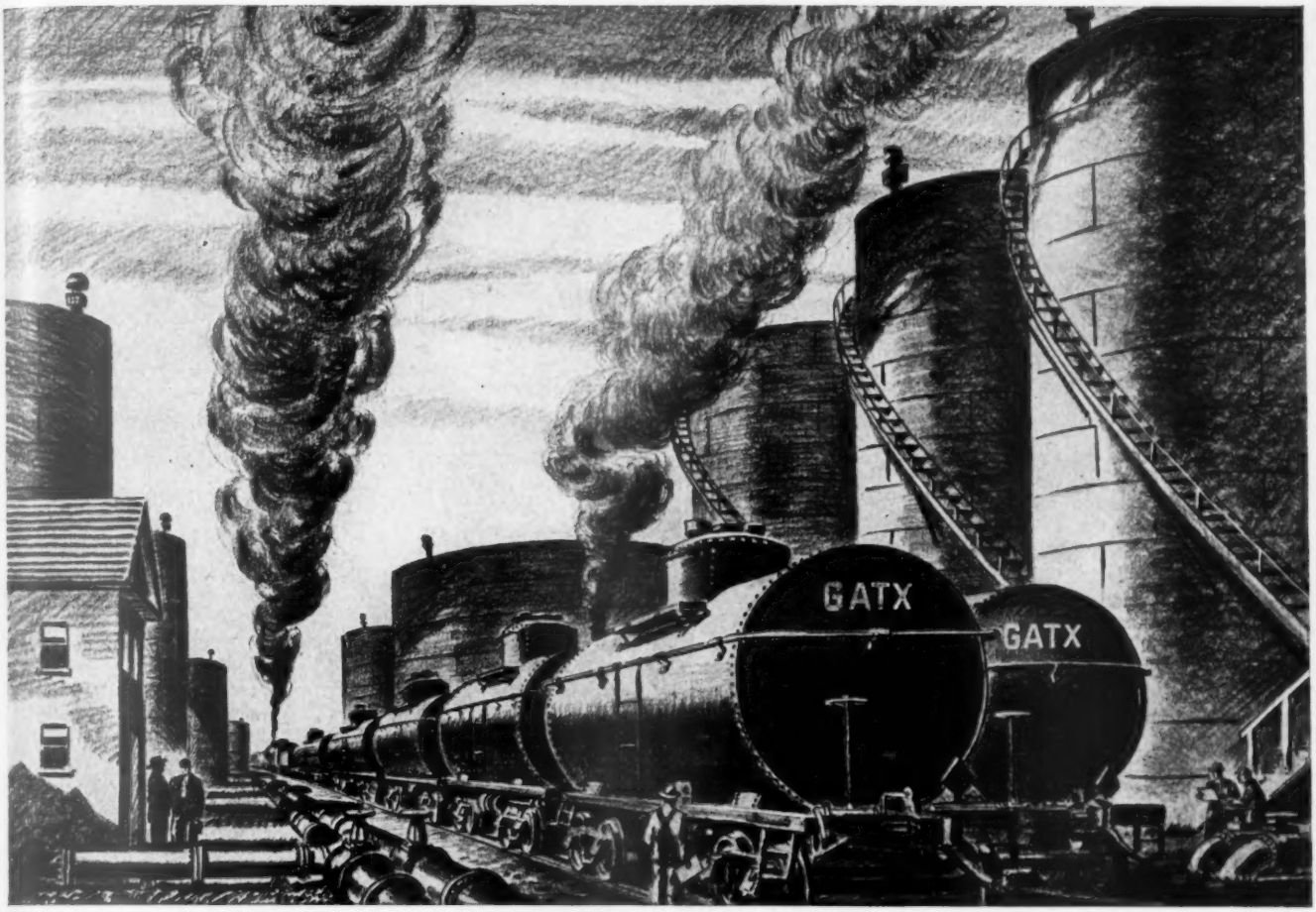
WASHINGTON—The resignation, effective Dec. 5, of Assistant Deputy PAW Bruce K. Brown and his return to Indiana Standard as general manager of that company's research and development was officially announced this week by PAW Ickes.

Both Mr. Ickes and Deputy PAW Davies paid tribute to Mr. Brown's government oil service, and expressed deep regret at his leaving. They pointed out, however, that he would continue to participate in the production of vital war products in his industry position.

Swanson, Veteran Official In Oil, Quits One Post

WASHINGTON—After some 20 years in petroleum work with the government, Jack W. Steele has retired from the directorship of the Petroleum Conservation Division and been succeeded in an acting capacity by Edward B. Swanson.

Mr. Swanson, formerly an associate conservation director, also will continue his present duties as Director of Research for PAW.



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Zook Assails National Planners' World Oil Plan; Asks Repudiation of Billion-a-Year Imports

NPN News Bureau

WASHINGTON—The National Planning Assn.'s recommendation of a billion-barrel annual importation of oil into the U. S. by 1950, as part of a suggested $10,000,000,000 "foreign trade budget", was vigorously attacked this week by Ralph T. Zook, prominent independent producer in Pennsylvania and president of the Independent Petroleum Assn. of America.

Mr. Zook charged the national planners with fostering a world monopoly in petroleum, which would force domestic independent producers, refiners and marketers out of business, deliver the U. S. oil consumer into the hands of a few companies who own a considerable part of the domestic industry, drastically reduce tax revenues in producing states, and deprive landowners of millions of dollars they are now paid for exploratory rights and their share of the oil produced.

Meantime, NPN investigated the background of NPA's billion-barrel proposal. It was learned that the basic statistics upon which the billion figure was predicated emanated from the War Production Board, having been developed there by Mr. Stacy May, who until a month and a half ago was that agency's leading statistician, and a number of his assistants.

It was bluntly asserted by one official of WPB familiar with the statistics involved that, since oil reserves outside the U. S. and Russia can be expected to total 41 billion barrels in 1950, and ours are only 20 billion barrels, the U. S. should see to it that its reserves last as long as those of the rest of the world, "so that we can take care of ourselves in case of another war."

The I.P.A.A. president pointed out that if similar import proposals had prevailed in prewar years, "the present war would be over and the Axis would be victorious."

Zook Statement

Mr. Zook's statement read in part:

"Oil reserves which have won this war were found because the finders had a market for oil. Nobody looks for a new oil field in order to lock it up after finding it. Under the proposed program, few would try to make new oil discoveries in the United States.

"We would regard this proposal with less seriousness were it not for the fact that the National Planning Assn. has among its officers and trustees a number of men who occupy official positions in the United States Government. The chairman is a vice-chairman of the War Production Board. If they do not speak with official sanction, there should be a quick repudiation of the proposal they have made."

(Chairman of NPA is William L. Batt, vice-chairman of WPB and president of SKF Industries. Other prominent members are: Mr. May, Clinton S. Golden, vice president of United Steelworkers of America and a vice-chairman of WPB, and Charles E. Wilson, of the General Electric Co., until recently executive vice-chairman of WPB.)

Mr. May Explains

Meantime, in answer to an NPN request for the factors which the National Planning Assn. considered in arriving at its conclusion of a billion-barrel import by 1950, Mr. May said two were predominant: first, the need for oil conservation in the U. S., and second, the cheapness of Caribbean and Middle East oil, compared with that from domestic sources. At the same time, he made available to NPN a statement supporting the oil import suggestion of NPA's international policy committee. This stated:

Stacy May

"Although a domestic supply of 1,300,000,000 barrels of petroleum is suggested, it would appear desirable from a conservation standpoint and certainly cheaper, unless heavy tariffs were imposed, to import a large proportion of our petroleum requirements.

"Costs of petroleum delivered to the East Coast, which in normal years has about 40% of the U. S. consumption, from the Caribbean area and from Saudi Arabia and other Middle East areas are likely to be much lower than costs from domestic sources.

"The U. S. can produce petroleum from its 20,000,000,000 barrels of proved reserves, from new pools being discovered at a decreasing rate, and from reworking of old pools. Nevertheless, for domestic production the period of diminishing returns appears to have been reached, whereas for foreign areas, which have larger aggregate proved reserves and less previous exploitation and prospecting, cost may be expected to continue low, if not to decline.

"It is probable that the billion barrels of petroleum imports suggested . . . could be delivered to the East Coast for less than a dollar per barrel. Annual outlay might amount to $750,000,000."

Statistics upon which above statement and 1,000,000,000-bbl. recommendation were based, were developed by Mr. May and his assistants at WPB prior to his leaving the government agency to become assistant to the president of McGraw-Hill Publishing Co., a few weeks ago. A WPB official familiar with the projections drawn up told NPN that the 1,000,000,000-bbl. figure was "rather optimistic," and pointed out that it is just one part of a foreign trade budget which would be possible only under a very high level of employment and production within the U. S. in the postwar decade.

Independents to 'Suffer'

At the same time, this official said that it would "not be safe to assume" that imports would remain at 1,000,000,000 bbls.—if that level were ever reached—"because we (U. S.) have a number of low-cost producers who could give the foreign areas a tussle. But without doubt, the independent producer—who generally operates stripper wells, or other high-cost production—would suffer under such imports as suggested by NPA."

Estimated oil reserves in 1950 outside the U. S. were also given by the WPB official. A figure of 41,000,000,000 bbls. has been estimated by WPB's statistics and planning division as total oil reserves outside the U. S. and outside Russia in 1950. This compares with an estimated 33,000,000,000 bbls. at present, according to WPB.

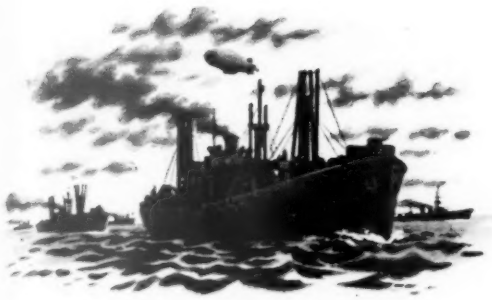
World consumption in 1950 is rather difficult of projection, the WPB official said, because of uncertainty over what demands will total in the war-torn countries of Europe. U. S. consumption, he added, is easier to guess at in 1950, because of more stable factors. The NPA, he said, estimates that U. S. domestic requirements in 1950 will reach 2,003,000,000 bbls., under full employment and utilization of our production facilities.

Would Mean Importing Half

Under this reckoning, it was pointed out, imports of one billion barrels in that year would leave only 1,003,000,000 bbls. to be supplied domestically, compared with a U. S. production rate, at present, of about 1,500,000,000 bbls. annually, which can be expected to rise even higher, through new discoveries.

Coincident with the release of "America's New Opportunities in World Trade"—the study developed by NPA's international policy committee—Mr. May appeared before a special House committee on postwar economic policy and planning, chairmaned by Rep. Colmer, of Mississippi.

Mr. May expounded at length on the program suggested by NPA, presenting the committee with the same suggestions—including a billion-barrel annual oil import by 1950—as had been released in booklet form earlier to the public.



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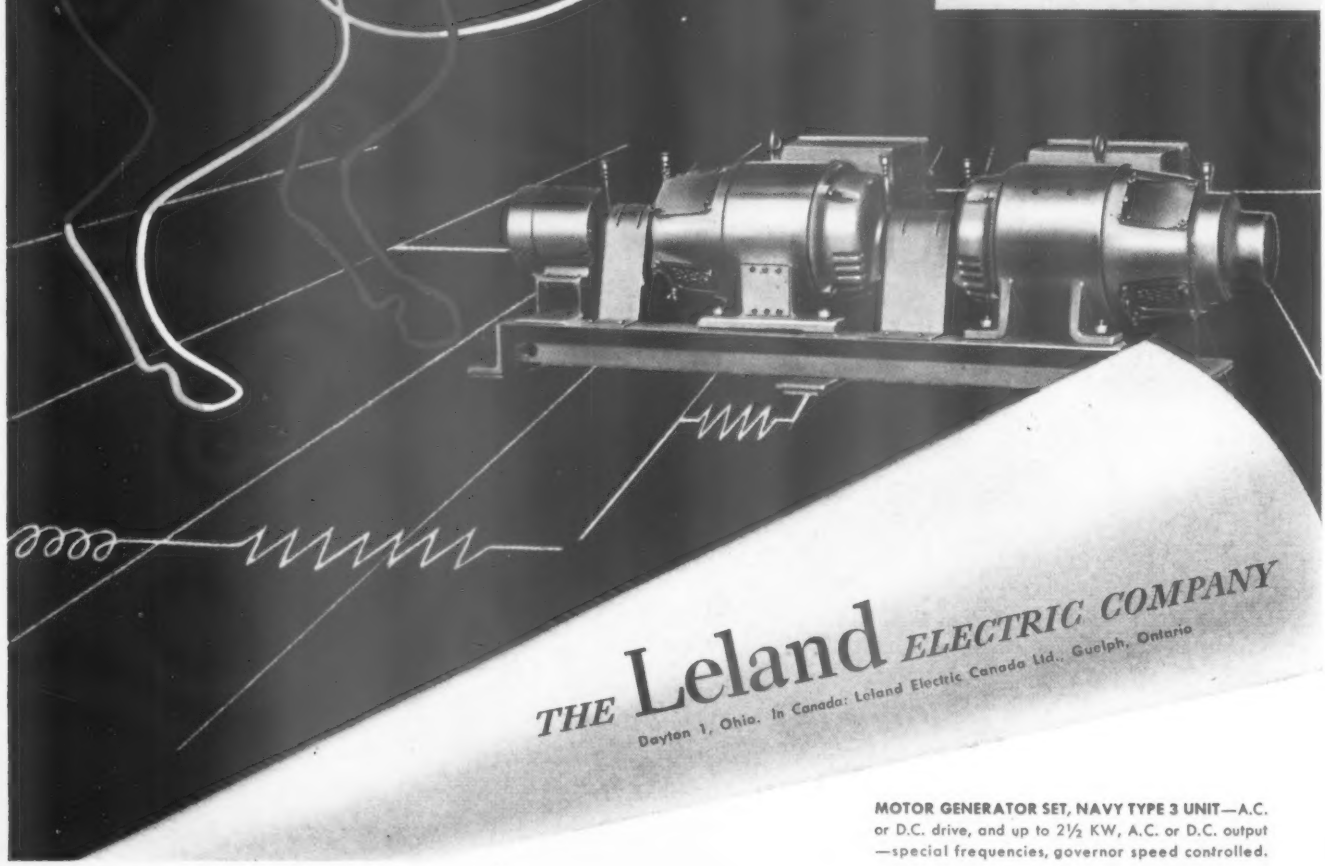

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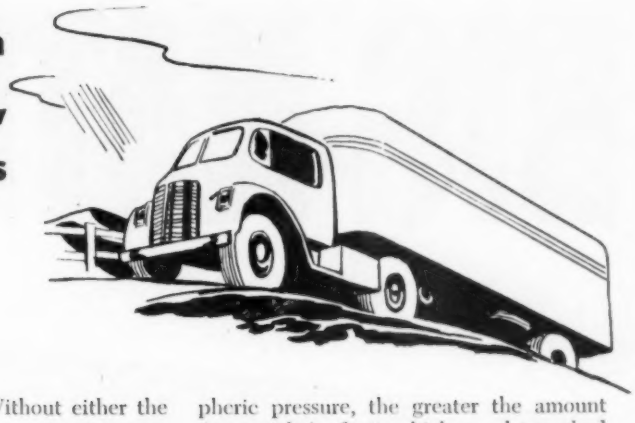

NPN News Bureau

CLEVELAND — The word "supercharger" has so often been brought before the public since the war began that it is now a part of everybody's vocabulary.

Every aircraft engine in combat service is equipped with one, and without the supercharger many American bombing raids would have been impossible and airplane designs would be considerably different from what we see today.

But to the bus and truck operator of the postwar future, the supercharger will mean greater payloads and lower cost per ton-mile. It will give him the extra power necessary to climb steep grades with greater speed, thus shortening the time for a run. Or, without increasing the size and weight of his engine, he will be able to haul a heavier load at no sacrifice in speed.

Tractors powered with supercharged engines will be able to do more work in a given day. Power shovels will be able to take larger bites and more of them every hour. Bulldozers, graders, scrapers will handle bigger loads at greater speeds.

Supercharging Boosts Pressure

Strictly speaking, "supercharging" refers only to charging air above atmospheric pressure. As applied to the internal combustion engine it means increasing the manifold pressure so that a greater amount of air is forced into each cylinder during its intake stroke.

The power output of a given diesel or gasoline engine is limited by its ability or inability to take in air. In order to produce power from an internal combustion engine, fuel must be combined with the correct weight of air or oxygen to produce the heat energy necessary to push the piston down. Air is as essential to an engine as fuel. Without either the engine will cease to operate—it stops.

Sometimes the ability of an engine's piston to take in air is referred to as "breathing" — much the same as the breathing system of a human being. An engine's breathing system can be good or bad, depending upon the design of the manifold, ports, valves, etc. If the breathing system is good then the piston on the downstroke will draw in nearly 100% of the displaced volume in the cylinder. If it is bad, it will draw in only a percentage of its displaced volume depending upon how bad it is.

In two engines, both of the same size, the engine with the good breathing system will develop more power because a greater weight of air will be drawn into the combustion space on each downstroke of the piston; consequently, more fuel can be burned and more power developed.

It is apparent then, that the ability of an engine to develop power (everything else remaining the same) depends mainly upon its breathing ability—or in other words—the weight of air contained in the cylinder at the time of combustion.

In a naturally aspirated or unsupercharged engine, the weight of air filling the combustion space must naturally depend on the pressure of the atmosphere surrounding the engine. The pumping or sucking action of the piston on its down-stroke or intake stroke creates a partial vacuum on the inside of the cylinder, thus enabling the atmospheric pressure on the outside to push air into the cylinder. And the greater the atmospheric pressure, the greater the amount (or weight) of air which can be pushed into the cylinder.

If we could control the atmospheric pressure at any given altitude, then we could control the weight of air going into the cylinder merely by changing the atmospheric pressure. If we wanted more power out of a given engine, we would merely increase the pressure and more air could be pushed into the cylinder.

Offers Simplest Method

We know, of course, that at any given altitude the atmospheric pressure cannot be controlled and therefore if we desire to increase the horsepower output of a given engine, we must resort to some mechanical means for increasing the pressure of the air supplied to the manifold.

A supercharger offers the simplest and most effective means for increasing the power output of an internal combustion engine without appreciably increasing its weight and overall dimensions. By reason of its positive and forced displacement of air, even under heavy load, the supercharged engine can deliver more power and has greater lugging ability for the tough emergency loads, which in the final analysis determine the operating load of the unit. Load capacity goes up and operating costs per unit of work go down.

The phenomenal performance of superchargers on aircraft engines in World War II has brought so much fame in a very few years to this means for increasing or restoring engine power that many to whom superchargers were previously unknown are apt to conclude that they are a recent invention.

Early Superchargers

Although "Supercharger" as a term for classifying the special types of blowers used to force air under pressure into internal combustion engines has been in vogue only since the early 1920's, this device, by whatever name called, is almost as old as the internal combustion engine itself. If we look back to the early days of engines in the 1880's and down through the centuries, we become aware that the basic principle of supercharging goes back probably further than the recorded history of mankind.

The original objective of supercharging was to furnish air at an increased rate to produce heat rather than mechanical power. The first ancestor of the super-

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Information presented in this article was obtained from a series of three papers by technical men associated with B-W Superchargers, Inc., Milwaukee, as follows:

(1) "Supercharging as Applied to Modern Internal Combustion Engines", by Donald A. Sutherland, Field Engineer.

(2) "Development of Superchargers", by E. W. Wasielewski, Chief Engineer.

(3) "Future Trends in Engines and Superchargers", by J. P. Stewart, Assistant General Manager.

Early type of "supercharger"

BIG NATION-WIDE

$115,500.00

IN WAR BOND PRIZES

ENTER TODAY

You can win up to $1,075.00

DISPLAY CONTEST—*GASOLINE*

DISPLAY CONTEST

Who said the war was over? *What war?*

Even if Germany were knocked out, there'd still be the Japs—a long, tough, costly job in itself!

That's why this 6th War Loan is so vital—why everyone must get back of it.

Your help is needed—the help of everyone in the Industry!

If you're a retailer—a gasoline station operator or a garage man—put a display in one of your windows, that will help sell War Bonds.

What's more, if your window meets the conditions of the 6th War Loan Display Contest, it may win you hundreds of dollars in bonds.

Read the rules carefully NOW . . . plan to get a display under way *before the day is over.*

10 SIMPLE RULES . . . *READ CAREFULLY*

1. Contest devoted to Window displays, interior station or store displays and exterior station or store displays devoted exclusively to the SIXTH WAR LOAN and installed during the drive. Each display must feature a $100 War Bond or reproduction thereof.*
2. Each entry is to be judged only in its own classified group; i.e., service stations and garages will compete only among themselves—not with the other groups, such as department stores, jewelry stores, etc.
3. Entries may consist of a single display or a group of displays. When consisting of a group of displays, each display must be a separate photograph, all joined together accordion fashion.
4. Entries are to be by unmounted 8x10 black-and-white photographs with the following information on back: name and address of service station or garage; name of display-man or employee responsible for the display; dates when display was on view to public; indication that your entry is in the service station and garage class.
5. The closing date is December 26, 1944, and all entries must bear a postmark not later than midnight of that date.
6. All photographs become the property of the Contest Committee and will be presented to the United States Treasury for such use as the Treasury may desire.
7. Entries will be judged for their bond selling appeal, attention value, artistry and originality.
8. The decision of the judges in all cases will be final.
9. The prize awards are to be payable to the individuals whose names appear on the back of the prize-winning photos.
10. All entries are to be mailed to the Sixth War Bond Display Contest, c/o DISPLAY WORLD, Cincinnati 1, Ohio.

*Use one of your own $100 Bonds or obtain a reproduction from your *local or state* War Finance Office.

See Your Salesman for Details

6380 PRIZES IN 11 CLASSES

War Bond Awards in the gasoline dealer class—$10,500
Total War Bond Awards in All Classes—$115,500
PRIZES ARE IDENTICAL FOR EACH CLASS

STATE PRIZES FOR STATIONS

First to Fifth, each.....$25 War Bond
Sixth to Tenth, each.....Honorable Mention
All Ten Win Right to Compete Sectionally

SECTIONAL PRIZES FOR STATIONS

First to Fifth, each.....$50 War Bond
Sixth to Tenth, each.....Honorable Mention
All Ten Win Right to Compete Nationally

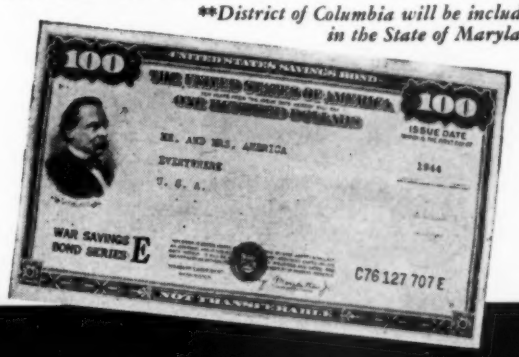
GRAND NATIONAL PRIZES

First Prize.....$1000 War Bond
Second Prize.....$500 War Bond
Third Prize.....$250 War Bond
Fourth Prize.....$150 War Bond
Fifth Prize.....$100 War Bond
Sixth to Tenth..... $50 War Bond
All Ten will also receive Treasury Citation

SUMMARY OF PRIZES IN GASOLINE STATION CLASS

**48 States with 10 Prizes each	480 Prizes
9 Sections with 10 Prizes each	90 Prizes
National Grand Prizes	10 Prizes
TOTAL PRIZES IN EACH CLASS	580 Prizes
TOTAL PRIZES IN ALL 11 CLASSES	6380 Prizes
TOTAL VALUE OF WAR BOND PRIZES IN ALL CLASSES	$115,500

***District of Columbia will be included in the State of Maryland*



DEALER SECTION

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charger seems to have been the blowpipe, a hollow reed held in the mouth to force air by lung pressure into a fire. The ancient Egyptians produced hot fires for working metals by using bag blowers operated by men teetering back and forth on the bags and operating flap valves for air inlet by strings held in their hands, thus forcing air through hollow bamboo tubes into the charcoal fires.

The bellows form of compression blower has persisted down to our own times. The leather hand bellows was used by the early settlers of this country to freshen the hearth fire for warmth and cooking purposes. The large forge bellows employed by the old time village blacksmith is another example of supercharging to produce a hot fire.

The invention of the centrifugal and fan type blowers introduced a radical change in design with advantages of compactness, the production of a continuous blast of air instead of the intermittent output of the bellows, and adaptability to power drives.

The idea of using a blower or compressor to force more air into the cylinders of an internal combustion engine is only about 10 years younger than the first engine exhibited by Otto and Langen at the Paris Exposition of 1878. The early builders of those engines soon realized that air was a limiting factor in the horsepower output of a given engine. By increasing the weight of air supplied to a cylinder, more fuel could be burned per power stroke with a corresponding increase in power output.

Various means have been tried for forcing more air into the cylinders, beginning with the use of the underside of the pistons operating in a sealed crankcase as in the Daimler two-cylinder car of 1889. Renault's French patent of 1902 provided for using the radiator fan for this purpose. The principal incentive for the development of supercharging came in Switzerland where the low-power automobiles of the 1900's negotiated with difficulty the mountain roads in the higher altitudes of the Alps.

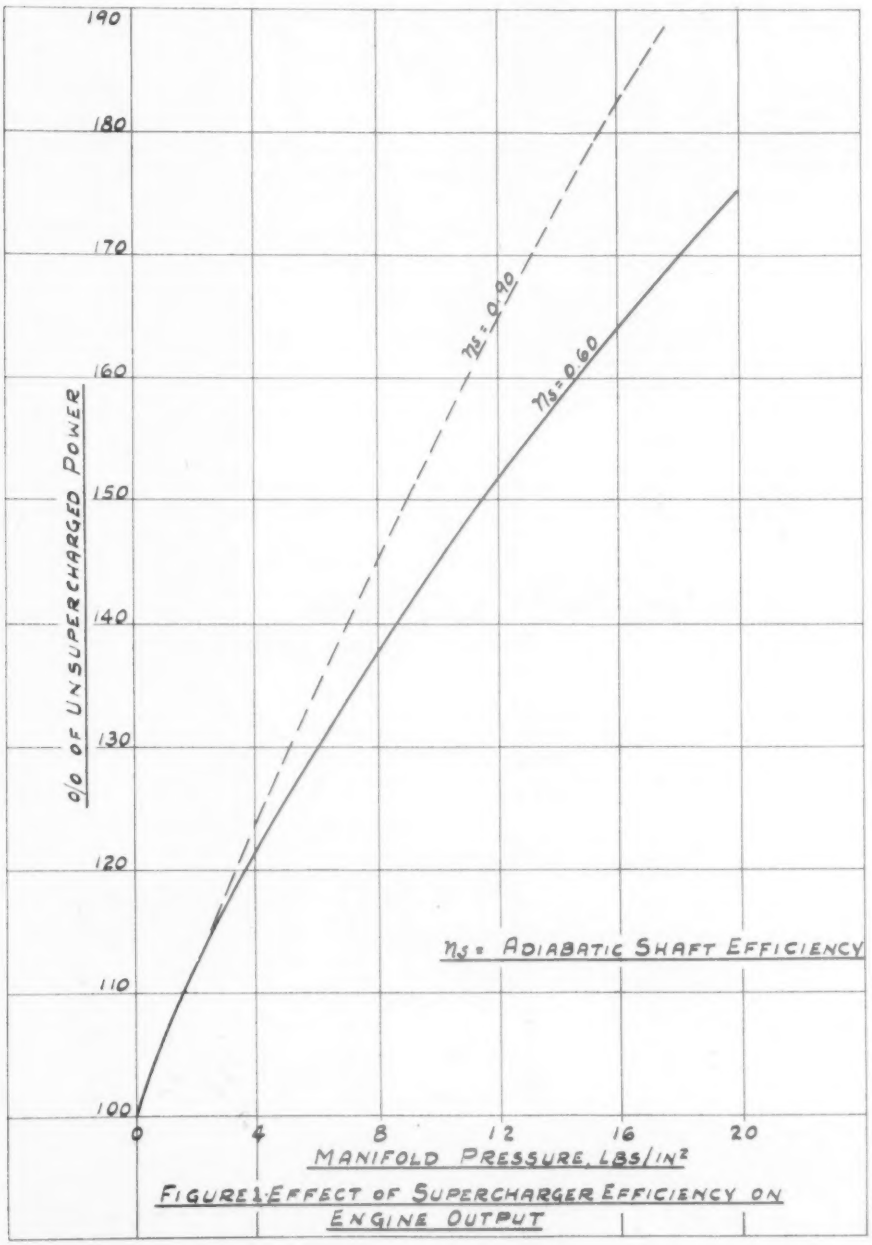


Fig. 1—Variation of engine output with manifold pressure for two values of supercharger efficiency. Although the curves tend to flatten out, it appears that there is no obstacle to prevent doubling the power of the engine. The engine being considered is a hypothetical one with air consumption per H.P. characteristic of an excellent Diesel or an Otto engine of average performance

Used in World War I

It was during the first World War that attention was seriously directed to increasing engine power by using a supercharger to produce a higher manifold pressure, but the principal concern was to prevent the power of the engine from falling off with altitude rather than to increase the performance of the sea-level engine. In line with this aim, considerable effort was given to the design of a supercharger for the Liberty engine as well as to the development of American and foreign exhaust-driven superchargers. Superchargers in the form of centrifugal compressors geared to the crank shaft were used by the Germans on airplane engines near the end of the war.

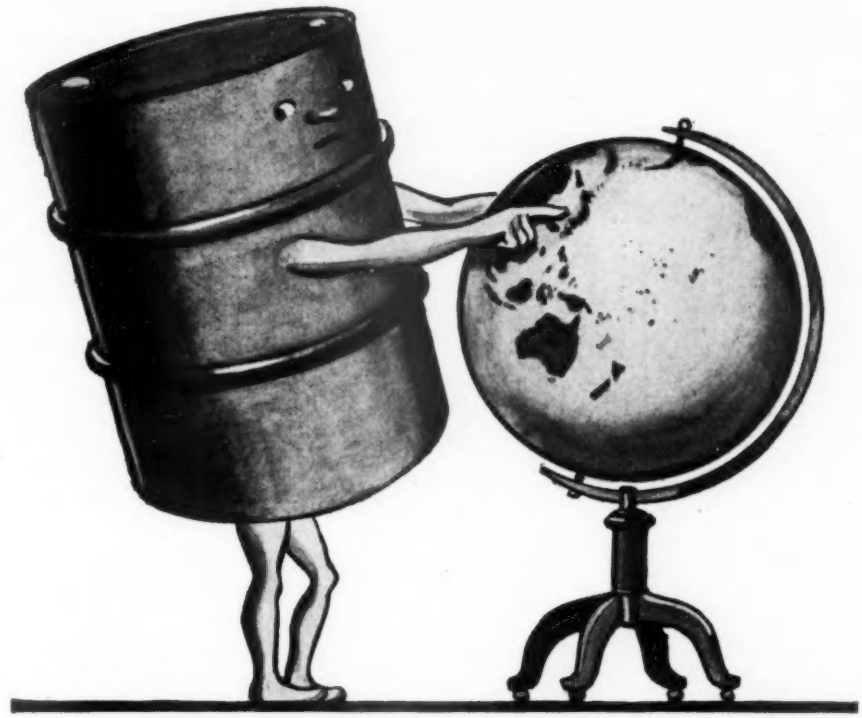
For a long time after the first World War the supercharger received very little attention. We find references, from time to time, to the possibilities of supercharging and experimental applications to automobile engines as well as racing cars, but little evidence of much work being done. Entrants in the Indianapolis Speed Races used superchargers on their cars to give them an edge over their competitors. As a matter of fact, a supercharged Duesenberg entry won the Indianapolis Race in 1924 and set the seal of approval on this device for increasing the power output of an internal combustion engine.

Around 1927 and 1928, there were signs of accelerated activity. More serious attention appears to have been given to the potentialities of the supercharger, and several different types were investigated. Evidence that it was still considered a gadget, however, is given by the fact that it was included in a discussion of design novelties at a meeting of the SAE. As far as the airplane engine was concerned, the supercharger was chiefly a means of improving the mixing of air and fuel by whirling the charge around after it had left the carburetor; it was, in fact, frequently referred to as a "rotary induction system."

At the same time, in one place we find the statement that the supercharger might be useful in some planes where increased power was required, but it could not be used on a long range airplane where fuel consumption was of greatest importance. There is reference to raising the manifold pressure to as much as one inch of mercury above sea-level pressure and the use of supercharging for maintaining sea-level power to around 5000 ft. Some

Tri-Sure News

NUMBER 24 ★ 30 ROCKEFELLER PLAZA, NEW YORK 20, NEW YORK ★ DECEMBER, 1944



"I've got a long way to travel, folks!"

"Yes, Uncle Sam has planned a long trip for me—and the end of the run is Tokio. Which means I've got to keep in shape—a lot better shape than some of the drums I've seen. The only trip they'll take is to the scrap heap. So, if you think I'm worth a lot more carrying high octane gas to where it's needed than adding a few pounds of scrap to the pile, keep this in mind: Every drum is needed now more than ever, and every drum is harder to replace. Help keep the drums rolling—in the right direction—by handling them with *care*."

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examples of supercharged diesel engines appeared around this time, but, on the other hand, in 1930 we find some discussion of the use of a supercharger as a starting auxiliary for diesel engines.

After this flurry of activity, supercharger development proceeded at a somewhat faster rate. The supercharger became a common, but by no means universal, adjunct to the airplane engine. A few more, but only a few, applications were made to various internal combustion engines.

Efficiency Improved Slowly

Shortly before this war, supercharging of airplane engines to give sea-level power at around 12,000 ft. was fairly common, but the limit of application of the supercharger seemed to be a pressure ratio of about two to one. Although considerable research work had been done, the efficiency of the supercharger had been improved at a slow rate. Incentive for more intensive work did not exist, since only a small number of internal combustion engines besides the airplane engine were supercharged at all.

With the advent of the war, however, the need for a large number of internal combustion engines for stationary, marine, and transportation use became evident. For many military applications, the maximum possible power had to be obtained from a given engine. Obviously supercharging was the best solution for this requirement.

As a result of the application of superchargers, the power of many engines was increased 20 to 30% and in some special applications, considerably more. Brake mean effective pressure of 130 psi and higher are now quite common in those Diesel engines which formerly operated with pressures of the order 100 psi.

The story of the advance that has been made in the field of superchargers during the last few years cannot be told for some time, but it is safe to say that the progress made during this war exceeds by a considerabl margin the progress made during the period of peace. Today a large proportion of four-cycle engines in military service is supercharged and manifold pressures of 10 to 20 psig are by no means uncommon, nor are pressure ratios as high as four to one in a single stage unheard of.

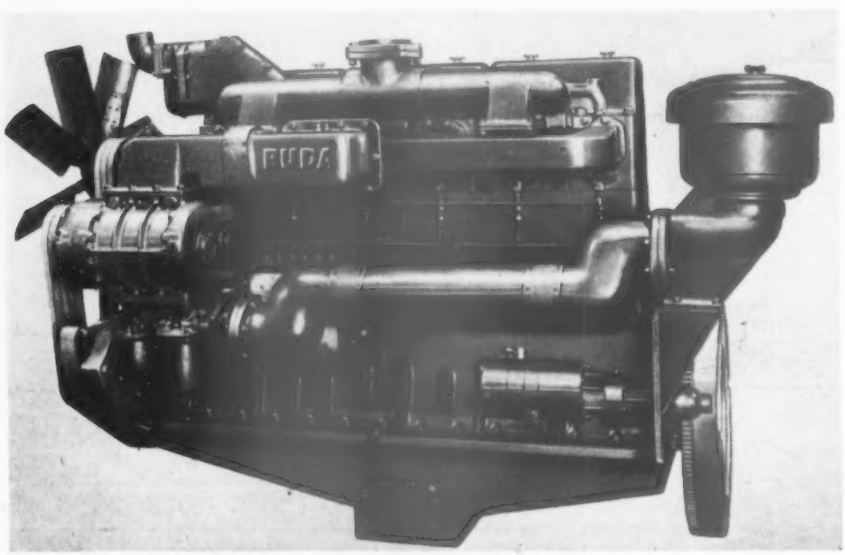
Fuel Change Not Necessary For Supercharged Diesel

CLEVELAND — What effect does the use of supercharging have on the type of fuel which an engine uses? In answer to that question, Eugene W. Wasielewski, chief engineer of B-W Superchargers, told NPN that:

"No change in the type of fuel for Diesel engines is required when the engine is supercharged. It may be desirable, however, to check the indicator card of the engine in order to determine if a slight change in timing might be advisable.

"In the case of Otto gasoline engines, the introduction of supercharging requires the use of a higher grade fuel. Although postwar fuel will certainly not approach the high octane rating which is presently being used in military aircraft, it may be said there will be a continued trend toward high octane gasolines. This trend can only be taken advantage of by increasing the compression ratio of the engine or by supercharging.

"Since Otto engines are approaching the point where an increase in compression ratio produces little if any gain in economy, it is obvious that the use of supercharging will produce far greater advantages than may be expected from increasing the compression ratio, although it is difficult to predict how much increase in manifold pressure can be tolerated by present designs of Otto engines, since this is a function not only of the fuel, but also of the engine design."



Typical application of supercharger to a Diesel engine

When we talk about the future of superchargers, we of course must talk also about the engines which they serve. Perhaps the most spectacular trend in Diesel engines has been the shift from the four-cycle to the two-cycle type in the last decade. Before the war two-cycle engines rarely were built below 1000 H. P.

Today, statistics released by the Navy indicate that at least 75% of all its installed Diesel horsepower is of the two-cycle type, much of it consisting of small engines. Further, there are numerous development projects now under way on two-cycle designs, some of these by manufacturers who heretofore have built only the four-cycle design. Such projects range from 15 to 2500 H.P. Furthermore, present two-cycle designs operate at higher piston speeds on the whole than the four-cycle engine.

This adds up to one inescapable conclusion—namely, that the four-cycle Diesel engine simply must be supercharged to meet this competition. In the words of Capt. Lisle F. Small, U.S.N., "I see no room in the future for the four-cycle naturally aspirated engine." This means that the four-cycle Diesel must not only go to higher mean effective pressures through supercharging, but also to higher piston speeds, in order to survive.

As an example of how the power output of a Diesel can be increased, one particular four-cycle engine was raised from 1000 to 1960 H.P. by a combination of supercharging and increased rotating speed. This is indicative of the power boosts which may be expected of the four-cycle Diesel—an increase of 75 to 100% above pre-war ratings.

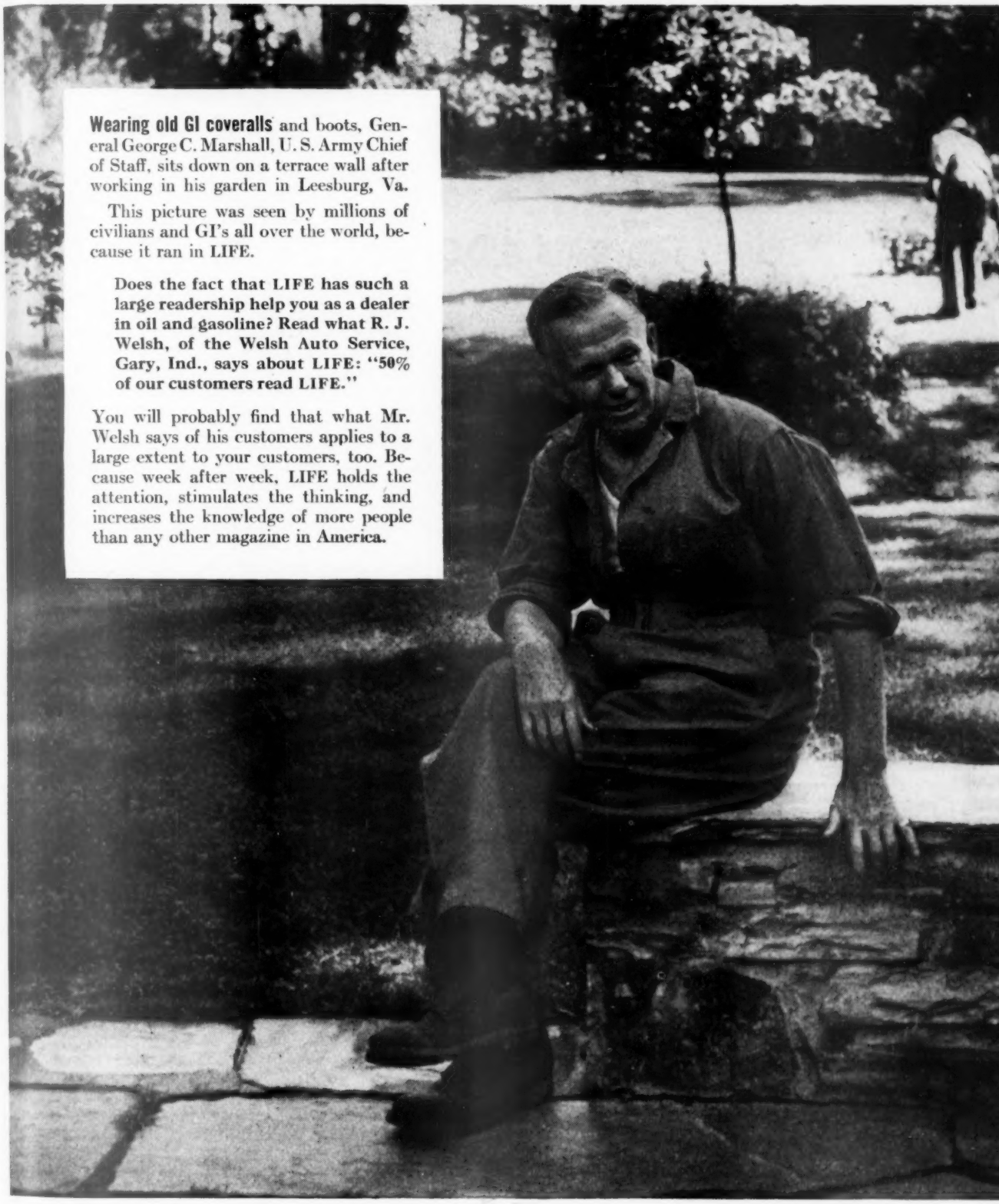
The Gasoline Engine Field

As for gasoline engines, these have been almost universally of the four-cycle type except for a few models of low ratings. This design will more than likely predominate for a long time, even though there is now a start of a trend toward two-cycle design in some instances.

To date, relatively few gasoline engines have been supercharged, and the possibility of general usage of supercharged gasoline engines in passenger automobiles is open to some doubt. Some favorable factors are the increase in availability of the higher octane fuels and the possible trend toward smaller and lighter weight designs. Offsetting these are the questions of public acceptance and the fact that the supercharger may be considered an extra complication.

Probably the most attractive field for supercharging gasoline engines is the heavy duty or "work horse" class of engine of 150 H.P. and upwards. Some work has been done along this line with very promising results and a great deal more work is now under way. The next several years will see perhaps more development along this line than

Millions saw General in GI's



Wearing old GI coveralls and boots, General George C. Marshall, U. S. Army Chief of Staff, sits down on a terrace wall after working in his garden in Leesburg, Va.

This picture was seen by millions of civilians and GI's all over the world, because it ran in LIFE.

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in any other part of the engine field. This work naturally will go hand-in-hand with the trend toward higher octane fuels. For comparative power boosts, supercharging pressures for these engines will be lower in general than for Diesel engines, although supercharger efficiency will assume greater importance.

The development of supercharged engines is in reality a three-way affair with the engine manufacturer, the supercharger manufacturer, and the fuel refiner all contributing. The supercharger must be an integral part of the engine if best results are to be obtained.

Another factor which must be given due consideration is the mechanical strength of the engine parts. In some cases that factor may constitute the most important limitation on power. With constantly improving materials, fuels, and designs, however, the supercharger will play an increasingly important role as manifold pressures rise.

Merits of Various Types

In talking about the future of superchargers, it will be realized that there is no universal method of supercharging which will cover all requirements. Each of the several types has its own merits for certain engines and services. Similarly, the various types of engines have their own individual merits for the many classes of service. Consequently, the following comments must be considered as general in character, since any categorical statement would have to be qualified in several ways.

The turbo-supercharger, which uses the exhaust gas of the engine to drive a turbine wheel mounted on the same shaft with a centrifugal compressor, has been confined in this country mainly to high altitude aircraft engines and to four-cycle Diesels with ratings of approximately 500 to 2000 H.P. In Europe, however, turbo-superchargers have been used on Diesels as small as 165 H.P. This type would have many attractions for smaller Diesel and gasoline engines, primarily because of its self-regulating characteristics and increased efficiency due to utilization of energy in the exhaust gas. The principal obstacles to the broader use of the turbo-supercharger for small engines have been first cost and problems incident to the high temperature of the exhaust gas. Neither of these is insurmountable, and it is quite possible that the next several years will see a broader use of the turbo-supercharger for both gasoline and Diesel engines.

The mechanically driven centrifugal supercharger has been restricted so far to relatively few applications outside of aircraft engines, although it does have merits for certain specialized designs. Much progress has been made during the past several years in the design of centrifugal superchargers toward improvement in efficiency and increase in pressure ratio that can be produced in a single stage.

The mechanically driven positive displacement blower has been used almost universally on two-cycle engines from the smallest to the largest, and on four-cycle engines with ratings principally below 500. While part load engine economy is not as favorable with this type as with the turbo-type, developments now in progress toward increase of supercharger efficiency, utilization of inertia effects, and improved methods of control, should increase its attractiveness materially.

The economic question is, by and large, the final answer to the future of supercharging. An internal combustion engine is a prime mover to produce mechanical power. Consequently, the winner in the race will be that type of engine which can produce power at the lowest net cost per unit of work done whether it be kilowatt hour, ton mile, passenger mile, or other yardstick for the particular service. This naturally is a combination of many factors, including first cost, fuel consumption, repair and maintenance cost, and availability factor. In a truck, for instance, a supercharged engine may result in reduced first cost due to a shorter and lighter chassis, thereby resulting in additional payload. In a bulldozer it may mean that extra margin of power required to complete the job on scheduled time against unforeseen obstacles. All of such factors must be considered to get the true perspective of the problem.

A detailed discussion of the services in which supercharged engines will be used in the future would take considerably more space than is available here. Briefly, however, it appears as a result of careful market surveys that the land transportation field as a whole offers the greatest opportunities. In this is included buses and trucks powered by Diesel and gasoline engines.

Diesel powered locomotives should be in considerable demand to replace worn out equipment. Construction and heavy farm machinery should be other fertile fields for supercharged engines. The marine field should represent a moderate market for small and medium-sized engines for pleasure and commercial uses. There should be a large demand for engine-generating units from small sizes such as used on farms to the larger power plant units.

In short, practically the whole internal combustion engine field may be considered as eligible for the benefits to be gained by supercharging.

Brooks Urges Slash in Oil Reserve Estimates Because of Decline in Discovery Rate

NPN News Bureau

NEW YORK — Estimates of known petroleum reserves in the United States must be revised downward, Benjamin T. Brooks, consulting engineer, told the annual meeting of the American Society of Mechanical Engineers here last week. Mr. Brooks said that the revision is necessitated by the fact that wartime rates of oil production have reached an all-time peak while there has been a "serious decline" in the rate of discovery of new oil.

Mr. Brooks said that although our knowledge of oil geology has improved tremendously, "costs of crude oil and all petroleum products in the United States will certainly continue to rise because of low rates of discovery independent of inflationary trends and other causes.

The only factor likely to curb this development, he said, "seems to be imported oil and this may not follow, as foreign producers may likely follow the domestic price scales without depressing them."

Mr. Brooks referred to a recent statement by A. I. Gregersen, PAW oil geologist, that exploratory oil drilling in California had reached a new high while the volume of newly discovered oil had touched an all-time low. He declared that "at the proper rates of production, we can no longer supply our normal annual domestic demand from American fields," and pointed out that costs of drilling and exploration have risen sharply during the last five years while "continued conflict of interests between American producers whose costs are high and other producers whose costs are low can be expected."

Although they believe that economic factors governing the selection of fuels for the Merchant Marine continue to favor oil rather than coal, David M. Schoenfeld of Combustion Engineering Co., Inc., and George P. Haynes of Todd Shipyards Corp. warned in a joint paper that shortage of fuel oil and increases in its price may cause changes in ship fueling in the direction of coal which, they said, "is available at East Coast ports at a lower price on heating value basis than fuel oil."

11 More Shipwrecked Seamen Saved by Tide Water Ship

NPN News Bureau

NEW YORK — Eleven shipwrecked seamen and the second officer of the Mexican tanker Juan Casiano recently arrived in New York, on Tide Water Associated Oil Company's tanker, Axtell J. Byles, commanded by Captain John D. Baldwin.

The Juan Casiano was sunk in collision with another vessel the latter part of October during a hurricane in the Gulf of Mexico. The men were picked up after floating on life rafts for three days.

The rescue raised to 255 the number of people saved from drowning at sea by Tide Water Associated tankers on four occasions in the past five years.

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With Warren Platt Overseas

Rivalries Forgotten As British Board Welds 17,000 Workers Into Unified Organization

By Warren C. Platt

LONDON — The British Petroleum Board tackled an interesting and difficult problem when it undertook to weld into one nation-wide organization all of the 17,000 employes of all of the light oil companies and their light oil departments in England, Wales and Scotland. Most of these were men who had grown old in company service and accustomed to the rules and practices of their individual employers.

Mr. Platt

The Board had more managers and executives, so to speak, than it would have needed on a national peacetime basis. There weren't managing jobs at bulk plants and terminals for all of these old managers; they had to be put into various positions where they could best serve the Board and the country, even though those positions didn't hold any particular executive responsibility.

The writer has spent quite a few days visiting around England in this distributing organization and if an opinion would be permitted it is that all of these men have fitted themselves into this new war organization in excellent shape. There seems to be a great absence of personal jealousies. Former managers of the oil companies are now cheerfully working in more humble jobs, often under the control of managers who, in peace time, were their competitors and equals.

Employes also have been switched around where they would best serve, with the result that there has been a great deal of changing. Men have their families in one part of the country and are working in other parts, some living at hotels and some still sleeping on cots in hostels or backroom of offices belonging to the Board. These men have been recruited from 22 major oil companies and 75 gasoline distributors who have tank trucks and storage.

Want Licensing Plan Continued

The gasoline dealer organization in 1938 totaled some 35,000. Their number has been reduced to about 20,000. These are small retailers. Generally they operate garages or do repair work, and the number includes retail cross-road stores that sell most everything.

There are about 100,000 gasoline vending pumps with a rough pre-war average throughput of about 9000 gallons per year, but a few dealers at the edge of large cities will do upwards of half-a-million gallons a year.

The gasoline dealer organization is urging on government and industry that the licensing system which has obtained during the war be continued, and that no new dealers be created except for excellent reason. At the present time in all lines one must get a license to open for business and one must also get a permit for his supplies from the local authorities when he comes back from war to resume his old business. Some fine arguments are reported in the newspapers where local authorities have been loath to give the returning soldier a license, but when the British soldiers return by their hundreds of thousands it is not expected that the dealers' effort to maintain a limited membership in that business will be continued, let alone be successful.

The largest single group of employes of the Board are the truck drivers. They now number 6250, an increase of 1000 from even a year ago. There also are 3250 women, over 2000 of whom are clerks and temporary employes. The rest of the women can be said to be doing "war woman's" work, some of it even man's work.

Warren Platt tells how British oil men, many of them prominent executives in peacetime, submerged personal ambitions and took whatever jobs assigned them as their contribution to the war effort in the accompanying article, the fifth in his series on the British Petroleum Board

Lost Heavily to Military

The Board lost employes of all classes quite generally to the military services. Up to the present time those losses total 7000—almost 40% of the original staff. But new men had to be added—a total of more than 5000 in addition to replacing those lost to the army, so there are now 11,000 of the Board's employes who have been taken on since the war. With the exception of truck drivers and a few key men these new employes are not A-1 grade of soldier material. A great many are veterans of the last war. Many are physically incapacitated for any really hard work.

The Board early had to ask the military authorities to stop drafting its drivers. The Board had about the same success with its request as the American oil industry had with its National Selective Service System. But with all of the demands placed upon the board and its transportation facilities by so many activities in addition to the needs of the army, the Board was soon able to drive home to the military authorities that without sufficient transportation from its own organization, meaning the truck drivers, there would not be any oil and gasoline for the war.

So exemptions were allowed and the Board was permitted to increase its number of drivers. But at that it couldn't get enough. Even at the start of this year, when the big bombing raids over Europe began, the Board wanted 600 more drivers and 300 additional 2000-gal. tank trucks. It got neither.

It was necessary to arrange with existing drivers so that equipment moved 22 hours a day and seven days a week, with four hours a week layover for maintenance work. In addition, truck speeds were stepped up as well as the length of hauls. By manipulation of working schedules this program was carried out with the drivers working on an average 50 to 52 hours a week and on emergencies as much as 60 to 64 hours a week.

Co-operative Management Works

The Board also in rough effect put the operation of its truck fleet in the hands of the drivers and the bulk plant operating men themselves. The Board asked the men to organize local committees and pointed out that it was impossible for the Board to give very detailed supervision against all of the emergencies of the war from London; that the Board had to look to the men to do the supervising to make sure that trucks did all of the mileage that they should in a given 24-hour period.

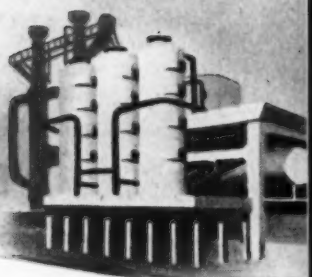
The result was the appointment in local areas of a Traffic Control Officer —generally a top-notch truck driver himself. He was instructed by the higher officials on good truck performance then he in turn saw that that performance was obtained. Figures show a very great improvement since the installation of this co-operative management system, so to speak.

Because the Board had to use its truck drivers just as the general uses his army and move them in large numbers to different parts of the country on emergency service, it was necessary for the Board to work out many kinks in getting this type of operation established. As has been explained in previous articles, the big development of bombing raids and of army camps with the influx of the American soldier and the great exodus of soldiers to North Africa and then to France, created widely varying demands for petroleum products at widely different points. The Board has found that about one-half of its men, 3000 drivers, are away from home nearly all the time.

To keep this from being a hardship on the drivers and their families the Board, through the men and their committees, has worked out a swing shift arrangement so that the men take turns in being away. Through this swing shift arrangement the Board also was able to maintain surplus driving time of drivers, which driving time could be called on in an emergency.

Having men away from home, especially in a country whose hotel and restaurant facilities were already under

TO WEATHER POST WAR *UNCERTAINTY*



A chemical plant designed, fabricated and erected by Blaw-Knox for large midwest manufacturer.

Naturally you want to establish yourself quickly and permanently in the post war era. To help you, Blaw-Knox offers engineering and products of wide range. It also has the facilities and personnel to manufacture for you, all or parts of your products.

One of the most important activities at Blaw-Knox is the Process Equipment Department, which among other things, specializes in the design and manufacture of equipment for the carrying out of chemical reactions by both the batch and continuous processes. This department is fully qualified to render a complete service from building pilot plants to equipment for full scale production.

Blaw-Knox leadership in the origination and fabrication of products for so many fields of industry is a ground for confidence that it can be of help to you if your business comes within the scope of its activities. Many Blaw-Knox products now of international reputation were originated to fill the needs of one manufacturer. Perhaps the Blaw-Knox umbrella of industrial coverage can include worth while services to you. May we talk it over?

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UNION STEEL CASTINGS DIVISION, Steel and Alloy Castings

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BLAW-KNOX SPRINKLER DIVISION, Automatic Sprinklers and Deluge Systems

Five Blaw-Knox Plants have been awarded the Army-Navy "E" for war-production excellence

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heavy strain and where food had to be very strictly rationed—far more than we in the U. S. have any idea of—the Board built and borrowed bunkhouses from the army, and in them billeted these men. These bunkhouses are located at the big terminals from which the trucks operate in largest numbers.

The bunkhouses are clean, neat, orderly, warmly equipped with good blankets, with comfortable bunks, there is generally a game room or lounging room and there is a good mess hall. The samples that the writer had of these messes permits him to say that they are excellent.

Feeding the men also permitted the Board to make sure of the right balance and quantitiy of diet, which is no small problem in England where you get 24 cents' worth of meat per week per person, and 24 cents doesn't buy any more meat over here than it does back home. The Board handles special ration books for these bunkhouses and also to give the men when they have to eat at points other than the Board's hostels and other than at regular army messes.

The men wear a simple uniform of a peak cap and a "pool" overcoat. "Pool" is the brief designation for the Board's operation and for itself and its equipment. In fact it sells "Pool" gasoline.—W.C.P.

How Government Compensates British Oil Firms

LONDON — The financial arrangement between the British government and the members of the British Petroleum Board at the present time is as follows:

The valuation of the member companies' assets placed at the disposal of the Board at the outbreak of war has been agreed with the government at, in round figures, $89,600,000. Additions since the outbreak of war amount to approximately $4,000,000, representing mainly completion of tankage schemes in hand at the outbreak of war. The pipeline schemes devised and constructed during the war have been financed by the government, the Board having acted as agents for the government in arranging their construction.

The remuneration authorized by the government to the Board, for distribution to the member companies, is calculated from (a) 7½% per annum on the capital assets, the initial valuations of $89,600,000 being increased by additions but successively reduced by depreciation at half yearly rests, and (b) 7½% per annum on the working capital, up to $112,000,000 (which after an audit investigation was accepted as the assessment of the working capital employed by the companies in their business as distributors before the war) and at 3% per annum on any excess over $112,000,000.

The working capital is defined as the Board's indebtedness to members—which arises from supplies, and for ocean freight and other charges paid initially by the members on behalf of the Board and subsequently reimbursed by the Board; the working capital so defined is assessed at the end of each month and averaged over six monthly accounting periods.

The total remuneration for each accounting period assessed as above is divided between member companies according to an agreed scheme under which the total sum available is divided into:

(a) An amount for division between the members proportionately to the valuations of their individual physical assets —as interest on capital in physical assets.

(b) An amount for division between the members proportionately to their individual participation in the working capital—as interest on working capital.

(c) An amount—referred to as commission—for division between the members on a basis which reflects their 1938 gallonage in the several products.

It will thus be seen that each member participates in (c) irrespective of the assets he contributed, and irrespective of his participation in the working capital, thus protecting the smaller members who, using hired facilities before the war contributed little to the physical assets, and have not the financial resources to participate to any large extent in the working capital.

As illustrating the remuneration received by individual concerns two cases have been taken at random. The first contributed assets with a valuation of approximately $36,000 and was trading in motor spirit and kerosine; the second contributed assets with a valuation of approximately $17,600 and was trading in motor spirit, kerosine and black oils. It is estimated that in the first case the total remuneration under (a) (b) and (c) up to June 30, 1944 will average approximately $2,800 and in the second case approximately $1,600 per annum.—WCP.

British Oil Statistics

MOTOR VEHICLES IN USE IN THE UNITED KINGDOM

	1929	1938	1939
Private Cars	998,000	1,984,000	2,130,000
Motorcycles	741,000	466,000	450,000
Taxis & Buses	50,000	36,000	36,000
Goods	326,000	499,000	510,000
Miscellaneous & Exempt Vehicles	25,000	68,000	90,000
Army & Police	50,000	51,000	51,000
	2,190,000	3,104,000	3,267,000

CONSUMPTION
(Million (Imp.) Gallons)

	1929	1938	1939
MOTOR SPIRIT:			
Private Cars & Motorcycles	320	700	650
Others	560	730	750
	880	1,430	1,400
DERV FUEL:			
Others	...	101	120

TRACTORS

Number	25,000	49,000	52,000*
Consumption Tractor Fuel (Million gallons)	20	43	48

*November, 1944—150,000

REFINERIES IN ENGLAND

Pre-war: 21 complete refineries with charging capacity of 5 million tons, or roughly 40 million barrels a year.

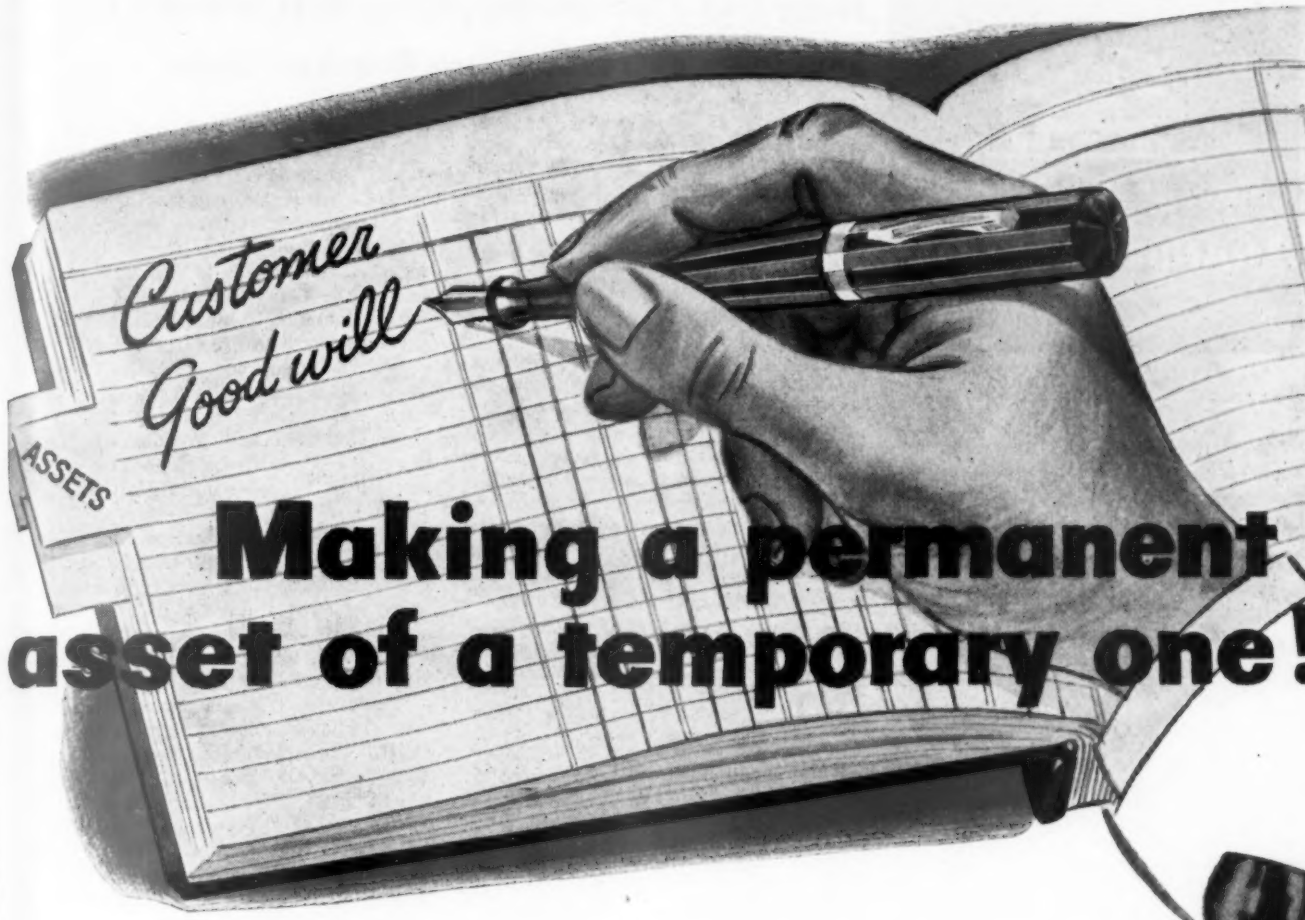
Plants now running: 13. Others are kept in stand-by condition at government expense. Refineries are charged with crude oil, top crude and some distillates imported from the Middle East, Venezuela and the U. S., except a production of about 700,000 barrels a year in England.

Illinois Station Sales Up For Sept. Over Year Ago

NPN News Bureau

CHICAGO—Spot check survey of the Bureau of Census among 106 Illinois service stations shows an increase of 6% in service station sales for September of 1944, in comparison with same period in 1943 and a 1% decline in September sales compared with August of 1944, according to survey report received here. Sales among the Illinois sample stations for September totaled $268,125.

Comparison of sales made in September of this year against September of last year for stations in other sections of the Midwest show the following percentage of increase or decrease: Ohio, 7% increase; Michigan, 5% decrease; Iowa, less than 0.5 per cent change; Missouri, 13% increase; Nebraska, 11% increase; Kansas, 5% increase. Twenty-two service stations in the Chicago area reporting showed a 5% increase with a total of $50,346 sales for the month.



Making a permanent asset of a temporary one!

Never before has the motoring public been so "spark plug conscious" as now. Perhaps never again will the dealer have the opportunity to capitalize on this general interest—to make of it a permanent asset.

Increasing economy, ease of starting, revitalizing old and mile weary engines are today demonstrable benefits of regular spark plug inspections and service or the replacement of worn-out spark plugs with new Champions.

Now is the time to emphasize these advantages. Now is the time to point out that *every engine,* regardless of age or condition, benefits enormously from regular and systematic spark plug service and replacement. Impress the customer with the fact that wartime necessity should become postwar habit.

Thus you can make a permanent asset out of a temporary one. Your biggest asset in spark plug sales is to stock and sell Champions—the preferred stock investment. Champion Spark Plug Company, Toledo 1, Ohio.

TO SAVE GASOLINE —KEEP SPARK PLUGS CLEAN

DEPENDABLE Champion Spark Plugs

IT PAYS YOU WELL TO STOCK AND SELL CHAMPIONS

December Car Quota 3000

NPN News Bureau

WASHINGTON—OPA this week announced that the December quota of new passenger cars available for rationing will be unchanged from November—3000 cars, with a regional and national reserve of 300 each.

The stockpile of new cars available for rationing is under 20,000, or less than a pre-war two-day supply, OPA said.

Breakdown of the December quota by OPA regions follows:

Region	Quota	Regional Reserve
Boston	235	24
New York	582	58
Cleveland	353	35
Atlanta	362	36
Dallas	605	60
Chicago	385	39
Denver	72	7
San Francisco	406	41

Ruling Affects All Products

NPN News Bureau

WASHINGTON—ODT announced this week that the recent reinstatement of the "less than 200 miles" provision in General Order ODT 7 Revised, applies not only to petroleum and petroleum products, but to all commodities moving in tank cars.

Included in the order are all chemicals, alcohol, vegetable oils, packing house products, molasses, coal tar products, etc. The order requires all shippers and carriers of liquids in tank cars to obtain permits for movements of less than 200 miles.

Huge Gas Pipeline Supplying East Escapes Shutdown as Texas Board Revokes Order

Special to NPN

AUSTIN, Tex.—The big Texas pipeline supplying eastern seaboard war industries with 200,000,000 cubic feet of fuel daily has staved off, at least for the present, the first real trouble it has encountered from the Texas end.

In a sensational move, two members of the Texas Railroad Commission signed an order which, if carried out, would have meant a shutdown of the big line.

Commissioners Ernest O. Thompson and Olin Culberson, charging that sands in the big Agua Dulce and Stratton gas fields were not being repressured as required by a previous commission stipulation, ordered immediate severance of all pipeline connections with operators drawing gas from those sands, and cancelled the tenders for the gas.

The Chicago Corp., parent firm of the Tennessee Gas & Transmission Co., is the biggest producer in the area and supplies Tennessee with its gas for the pipeline to West Virginia.

Rescinded Same Day

The commissioners who signed the order rescinded it the same day, pending a hearing on Dec. 18, after an immediate howl went up from Corpus Christi, teeming war city on the Texas Gulf Coast.

It developed that the Chicago Corp. also supplies gas for the city of Corpus Christi from the wells affected, as well as the Central Power & Light Co. generating station there. Following the order would have meant cutting off all power, light, and gas from a large area, including the giant naval air station outside Corpus Christi.

There was no interruption, however, for the Chicago Corp. announced that its "responsibility to the public is greater than its responsibility to the railroad commission" and refused to shut off the flow of gas. The commission order rescinding the shutdown came later in the day.

C. C. Small, attorney for the Chicago and Tennessee companies, said in Austin that the volume of gas required by the pipeline, which he said was built on orders of the War Production Board, could not be supplied if the commission's repressuring order were carried out.

"If the order is good for the Chicago Corp., it is also good for others similarly situated," he commented. "If it is applied to others it would certainly close 90 per cent of natural gas production in the state outside of the Panhandle (sour) gas field."

The commission's closing order affected six Agua Dulce sands and 14 Stratton levels. Gas is being produced from 25 sands in Agua Dulce and 14 in Stratton, but the ones ordered closed down were the fields' principal sources of production.

Commissioner Culberson said that the Dec. 18 hearing might be able to work out a production formula that would provide for returning a certain amount of gas to its original strata (after all but the methane had been stripped out)(, and allowing the remainder to be sent out through the pipeline.

He said there had been contradictions and confusion in the production areas, along with protests from royalty owners that their income had been too small. If a method is worked out, he said, it would exact strict uniformity and complete protection to all royalty owners in the area.

Culberson said any adjustment would demand the return of sufficient dry gas to insure maximum recovery of oil liquids in the field from the pressure generated by the returned gas.

The dispute came near going to court, either by the attorney general, on behalf of the commission, seeking an injunction to force Chicago Corp. to abide by the order, or by Chicago Corp. seeking an injunction against the commission order.

"I have always been on the side of the commission and have never taken a case against it," Mr. Small said, "and I would not take this one into court except as a last resort."

The attorney, a former state senator, insisted that a maximum amount of liquid is being extracted from the gas and that the reservoir pressure is satisfactory. There would be no saving, but rather added expense, in returning the gas to the sands after it had been thoroughly processed, he argued.

Mr. Small asserted that his company erected three plants at a cost of $6,000,000 to extract the liquid and return the dry gas to the reservoir. This was done before there was any market for the dry gas, he continued, but now, since the pipeline is providing a market for a vast amount of dry gas, the gas is much more

Tank Car Hauls to East Increase to 530,466 b/d

NPN News Bureau

WASHINGTON—Tank car shipments to Dist. 1 climbed to 530,466 b/d during the week ended Nov. 25, the highest since Sept. 30 when movement averaged 535,907 b/d. Shipments averaged only 515,148 b/d during week ended Nov. 18. Tank car loadings by individual companies were as follows:

Aetna	16	Elk Refining	15	Richfield	123
Allied	46	Franklin	6	Roosevelt Oil	8
Amsco	110	Freedom Oil	3	Root	35
Arkansas Fuel	235	Gulf	2233	Royal Petroleum	42
Ashland Refining	89	Hartol	132	Shell	650
Asiatic Petroleum	34	Hess, Inc.	14	Sinclair	331
Atlantic Refining	632	Home Oil	34	Socony-Vacuum	2970
James B. Berry Sons	18	Jenny Mnfg. Co.	13	Southland	2
Cantelou	41	Libby	4	S. O. California	5
Chalmette	22	Maritime Oil	163	S. O. Indiana	389
Cities Service Oil Co.	373	National Refining	19	S. O. Kentucky	41
Cities Service	72	Ohio Oil	73	S. O. New Jersey	2441
Coastal	15	Pacific	78	S. O. Ohio	353
Continental	40	Pan American	1014	Sterling	31
Cooperative G.L.F.	1	Petroleum Corp.	1	Sun	1762
Cosden	64	Petroleum Heat & Power	47	Talco	28
Crown C.	20	Phillips	203	Texaco	1172
Danciger	57	Pioneer	1	Tide Water	80
Daugherty	7	Premier	15	Tiona	1
Dornoil	11	Primrose	30	Triangle	31
Drake	21	Pure	381	White Fuel	2
Eastern	130	Republic	209		

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LIGHT UP FOR ACTION

The day will come—soon, we hope—when the ration coupon will be history. Boarded-up service stations from coast to coast will be reopened and competitive selling will be here again. Complete service station lighting will be a powerful factor in helping you get and maintain your business. Proper lighting means rapid identification . . . for increased sales.

With long experience in applying complete lighting equipment for this special application, Westinghouse is able to provide recommendations and plans for installations in future stations.

Floodlights to emphasize completeness of service facilities and distinguish the station from competition.

Driveways free from shadows and glare, for safer and faster flow of traffic . . . Lighting on pump islands to facilitate brand recognition and servicing . . . Well-lighted display windows and cases to increase the attractiveness of auxiliary merchandise and speed selection and selling . . . Rest rooms lighted for clean and attractive appearance . . . Adequate lighting in the office and service bays for fast and accurate work . . . Westinghouse can supply all this equipment to make your station more profitable. For service station lighting aid that is complete and reliable call your Westinghouse distributor. Westinghouse Electric & Manufacturing Company, P. O. Box 868, Pittsburgh 30, Pennsylvania. J-94650

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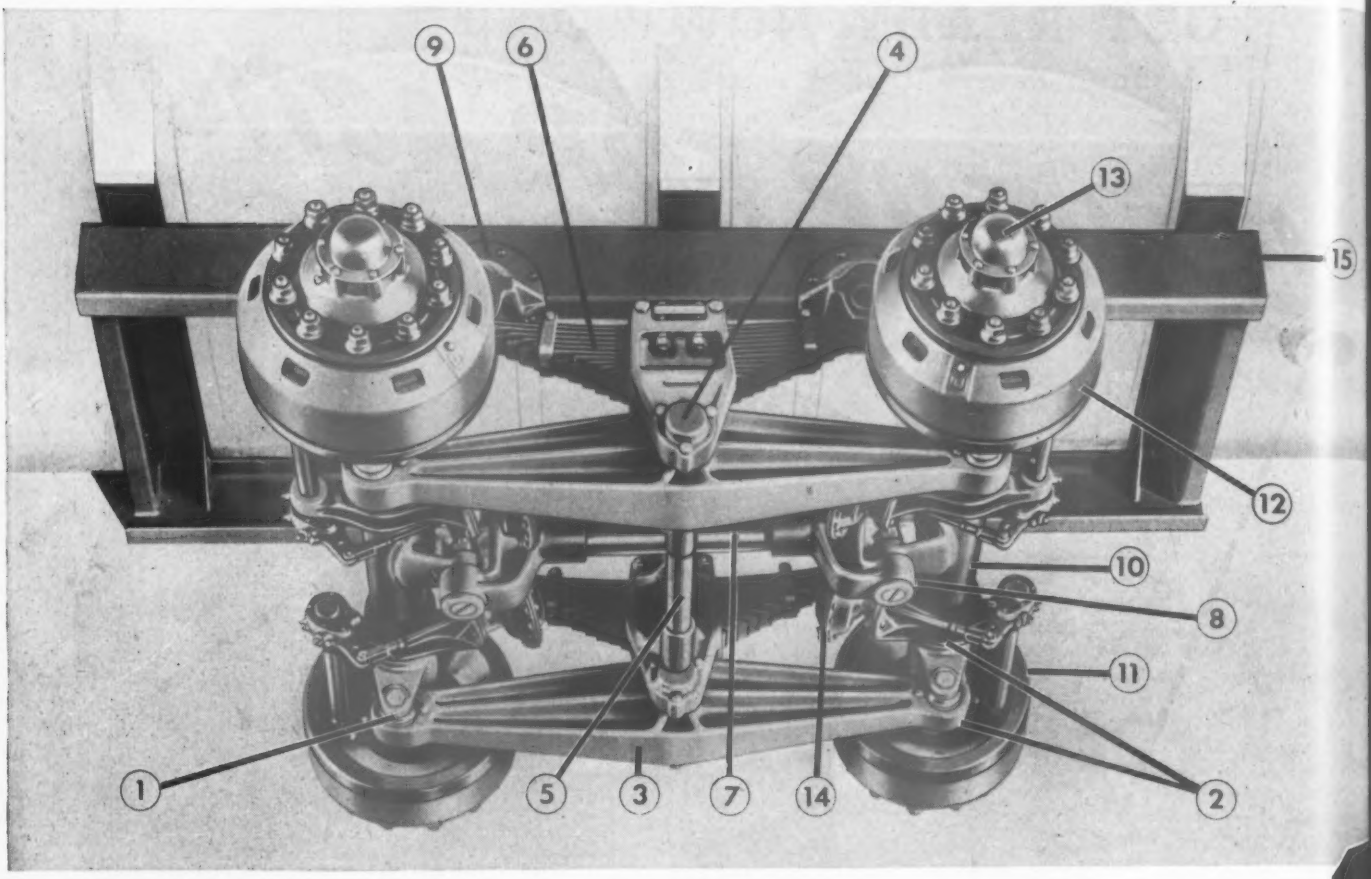
Westinghouse Serves the Petroleum Industry from Drilling Rig to Service Station



Heil gives you the most satisfactory tandem axle running gear in use today...

Because tandem axle trailerized tanks are able to carry bigger, more stabilized payloads, they may often mean the difference between a profitable and non-profitable operation in those states where road laws permit carrying increased gallonage in tandem axle units. The famous Heil tandem axle combines maximum flexibility with rugged, dependable, long-life performance that requires minimum service attention. Check these outstanding features:

1. Ball and socket joints at each end of equalizer beams hold friction to a minimum—provide maximum flexing action — reduce tortional stresses.

2. Equalizer beams are mounted below the center of the axle, using the load to absorb a portion of the torque normally caused by braking.

3. Rigid equalizer beams eliminate misalignment of axles caused by an uneven deflection of springs.

4. Long wear. replaceable bronze bearings pivot the equalizer beam for uniform distribution of weight on four wheels.

5. Thrust bar keeps both springs parallel—eliminates any tortional side deflection.

6. Springs are restricted to load carrying function only. They are not relied upon to maintain axle alignment as expected in ordinary tandems.

7. Exclusive Heil designed torque tube provides the necessary torque reaction for braking without transmitting this force to any part of the tank structure.

8. Rubber bushed torque tube yokes require no lubrication.

9. Four point mounting of the entire tandem suspension distributes load more equally.

10. The Timken Tubular steel axles save weight yet are so rigid that they have the ability to withstand the downward thrust of the payload and the twisting effects of sudden brake application. Maximum stiffness and a slight camber to meet the average crown of roads assure proper wheel alignment...extend tire life.

11. Heavy duty two shoe brakes with "S" type, constant-lift cam to assure even application represent the best in efficient brake application. Excessive operating temperatures, responsible directly or indirectly for a larger number of brake failures, are reduced to a minimum by the wide shoes and linings which permit a small diameter drum. This provides room for a cooling flow of fresh air between drum and tire rim for more rapid dissipation of heat.

12. Wide brake liners reduce pressure per square inch resulting in smoother, more uniform brake application, increased liner life and reduced "fading."

13. Generous, oversize tapered roller bearings let wheels run freely. Adjustments are easy to make and stay "put" once they are made.

14. All Heil Trailerized Tanks may be equipped with Westinghouse air or Bendix vacuum brake systems. Both systems have correctly sized chambers operating brake cam shafts through slack adjusters which can be quickly and easily adjusted for brake lining wear.

15. Mounting frame is an integral part of the tank structure eliminating the welding of longmembers to tank shell which is apt to produce localized stresses and leaks. The correct arrangement of interior heads and baffles plus the exclusive Heil method of attaching running gear supports to three integral tank bolsters prevent any localized strains on the tank itself.

Designed to meet specific road laws

To move a lot of gasoline fast . . . the petroleum industry depends on Heil Trailerized tandem axle tanks and Trailerized tank trains. If your hauling problems require maximum payloads under specific road laws, Heil Trailerized tanks will give you greater total gallonage at lower costs.

These self-aligning tandem axles are so suspended that the natural tire drag and wear produced in turning is minimized and lowers the bearing load on supporting members. Uniform traction and braking on all four wheels eliminate jump and chatter—provide smooth, positive starts and stops. Ample testimony from experienced operators establishes this as the most satisfactory tandem in use today.

The petroleum industry relies on dependable Heil "Trailerized" (frameless) Tanks like these to move a lot of gasoline on time.

Heil "Trailerized" design utilizes the inherent strength of the tank itself to give far greater beam strength than any trailer frame.

HEIL eads the way in weight-saving . . . for greater payloads

You get less time out for routine maintenance — fewer road delays due to breakdowns . . . steady rolling . . .

By correctly applying proved engineering principles, Heil has been able to reduce costly dead weight to a minimum. This means greater payload to increase the profit on every job you haul. In addition, you get less time out for routine maintenance — fewer road delays due to breakdowns—and steady rolling, around the clock, to pile up big gallonage totals. Ask any experienced user for verification of these claims and he will tell you that Heil's quality standards are factors you can depend on. Add to this the experience gained in The Heil Co's exacting war production work — and you see why these standards are even higher today than ever before.

For safe, good looking, money-making equipment that builds your reputation for on-time delivery, specify "Heil Trailerized Tanks" on your government applications.

Write for further information.

T-123

ARMY NAVY

THE HEIL CO.

GENERAL OFFICES • MILWAUKEE 1, WISCONSIN

valuable for use as fuel than would be if returned to the sands. There is no waste when the gas is used for a good purpose, he said. (The powers of the Railroad Commission hinge largely around the expression "to prevent waste").

Other operators in the area who were affected by the closing order were the Agua Dulce Co., the Gulf Plains Corp., L. M. Lockhart, United Gas Pipeline Co., and the Union Producing Co. All sent their attorneys to Austin to intervene with the commission against enforcing the order.

In the meantime, a general hearing is scheduled for Dec. 8 on the petition of the Chicago Corp. to determine whether the present methods of producing from the fields constitute waste.

Texas-California Sour Crude Hauls Due to Start Dec. 15

NPN News Bureau

WASHINGTON—Start of tank car movement of West Texas sour crude to California by Dec. 15 is now the PAW goal.

First of the contracts, under which Defense Supplies Corp. will make direct payment of rail charges involved, now is before DSC for review and final decision is expected to reach the agency within the next several days. Initial contract is with Pathfinder, and will cover movement of between 3500 and 5000 b/d.

Goodrich Offers New Tread

AKRON, O.—B. F. Goodrich Co. has announced the first new-design car tire produced and marketed by a major rubber company since the start of the war. It is called a mud-snow "shoe," and has a button-bar tread pattern. It is designed primarily for combination road and off-road service, and is expected to appeal to farmers, rural mail carriers, ranchers, salesmen and utility service men.

A.S.M.E. Hears Report On Rubber Behavior Under Stress of Heat

NPN News Bureau

NEW YORK — Laboratory work measuring the chemical changes taking place in natural and synthetic rubbers at high temperatures was described in a paper presented by R. D. Andrews and A. V. Tobolsky of the Department of Chemistry, Princeton University, at the annual meeting of the American Society of Mechanical Engineers on Nov. 30.

"The behavior of rubbers at high temperatures is of great importance," the report said, "because tires, particularly heavy-duty tires such as are used on trucks and military vehicles, often become very hot in service and quickly deteriorate. This is particularly true of synthetic tires which become hard and brittle, and then crack."

It was said that it had been found that in both natural and synthetic rubbers two chemical reactions take place simultaneously in the rubber at high temperatures, and change the structure of the rubber network.

The first reaction is one which cuts the long-chain molecules in the rubber, and the other is a reaction in which the molecular chains are linked together. Both occur in the presence of oxygen, and they are constantly competing with each other—each reaction undoes the work of the other.

On the subject of chemical changes with different types of rubber, the paper said:

"The cutting reaction tends to make the rubber soft and tacky, while the cross-linking reaction tends to make the rubber hard and brittle. Whether a rubber softens or hardens when it deteriorates at high temperatures depends on which of the two reactions is the faster. In natural rubber cutting occurs more rapidly than cross-linking at first but later the rate of cross-linking overtakes and passes the rate of cutting. This is the reason that natural rubber softens first and then hardens when it is heated in air at high temperatures.

"In Butyl rubber, cutting is always faster than cross-linking and so Butyl softens in heat aging. In GR-S, the main synthetic rubber manufactured by the government at the present time, the rubber molecules are always cross-linked more rapidly than they are cut. Therefore the rubber becomes hard and brittle if it is heated for any length of time. Buna N type synthetic rubbers also harden in the same way.

"The very good heat aging properties of Neoprene are not due to unreactiveness of the rubber, because both deteriorative reactions occur very rapidly in Neoprene. The reason is that the two reactions occur at almost the same rate, and so practically cancel each other."

Cincinnati Delays Action On Double-Bottomed Truck Ban

NPN News Bureau

WASHINGTON — Cincinnati's city council plans no immediate action banning double-bottomed petroleum trucks, it was learned this week, despite strong support from the City's police department. The Council's Law and Safety Committees heard both sides of the question at a joint session Nov. 27, attended by industrial leaders, Army officers from Wright Field, and Maj. Joseph E. Keller, ODT's adviser on state barriers.

Police officers attending the session said they objected to double-bottomed trucks because they "weaved on highways" and already had been involved in three Cincinnati accidents.

Walter W. Bryant, of American Casualty Co., said, however, that insurance firms charge no higher premiums for policies covering drivers of double-bottomed petroleum trucks than for other truck drivers.

Others opposing passage of the resolution which was introduced by Cincinnati City Manager W. R. Kellogg, were Ed. Kirby of the Ohio Commercial Haulers' Assn.; Pres. Elliott, of Elliott Transportation Co., Cincinnati; Fred Lautzenheimer of the International Harvester Co.; C. S. Franklin of Trailmobile Co.; and Harry Nichols, head of the traffic department of Cincinnati's Chamber of Commerce.

They told the Law and Safety Committee that (1) every available double-bottomed truck should be utilized to relieve current tank car shortage, (2) passage of the resolution would impose a difficult transportation problem, as trucks headed for the water terminal at Cleveland, O., or the refinery at Covington, Ky., use roads passing through Cincinnati, and (3) the resolution, if adopted, might delay gasoline shipments slated for Army Air Force Units at Wright Field.

Huge Airport Program Up to New Congress

NPN News Bureau

WASHINGTON—Congressional consideration of a $1,250,000,000 airport development program, proposed this week by the Civil Aeronautics Administration, is scheduled to get underway soon after the new Congress convenes Jan. 3.

The CAA report, which recommends construction of 3050 new airports and improvement of 1625 existing fields to meet the needs of the 400,000 aircraft CAA estimates will be in use within 10 years after the war, was referred to the House Interstate Commerce Committee.

The program would be financed jointly by federal and state governments on a 50-50 matching basis, state participation to be conditioned on meeting several requirements including one 100% use for aviation purposes of revenues realized from state taxes on aviation fuel.

CAA estimated the cost of the program at $1,021,567,945 for clearing, grading, paving, lighting and radio facilities, plus about $230,000,000 for land and buildings other than hangars.

The report recommended that Congress immediately appropriate $3,000,000 to cover cost of surveys and other preparatory work, and that the program, when authorized, be carried on at a rate calling for an annual Federal expenditure of not to exceed $100,000,000.

Copies of the report are being printed at the order of the Interstate Commerce Committee and are expected to be obtainable from the House of Representatives document room in two or three weeks.

SAY BOSS, THE PENNSYLVANIA SALESMAN IS HERE WITH THE 5 POINT POST-WAR PROGRAM YOU WANTED TO SEE
HE HAS Good News FOR YOU!
You will want to see the Pennsylvania 5 Point Program for Profit. It's an independent tire dealer's declaration of profitable independence. National advertising and a sound promotion program that go to work for you right now. Yes, nice going now—with top quality passenger car and truck tires, recap and repair materials, accessories, batteries—and, After Victory, you hit the jackpot! In protected territory you alone will sell the one nationally-advertised tire that is different—
The New PENNSYLVANIA Silent Vacuum Cup Tire
Designed for tomorrow's high speed driving, this patented tire grips the road—and tests show it stops faster than other tires by a wide margin. And this great safety vacuum cup tire is SILENT. Top safety—and silence! Good news for a select group of independent dealers who still believe the tire business is alive and growing and who intend to grow with it.
Pennsylvania Rubber Company, Jeannette, Pa.
NOW a complete line of truck tires, passenger car tires, repair material.
AFTER VICTORY a complete line, plus the New Silent Vacuum Cup Tire.
551
PENNSYLVANIA TIRES
MANUFACTURED BY THE ORIGINATORS OF THE Silent Vacuum Cup Tire

Premium Yields Unchanged

NPN News Bureau

WASHINGTON—Although PAW is still reviewing the situation, present indications are that yields of premium grade gasoline for civilian use will be maintained at 105,000 b/d during December, NPN was informed this week. Decision as to actual yields to be authorized is expected in time for a report to PIWC, which meets here Dec. 6.

Denver Refinery Move Denied

OKLAHOMA CITY — Report that Denver Producing & Refining Co. is planning to move its idle 1500 b/d skimming refinery at Gainesville, Texas, to a site near the West field has been termed "merely a rumor" by company official. Refinery has not been in use since 1939.

Sun Oil's $29,500,000 100-Oct. Cracking Plant At Marcus Hook Refinery Is Put on Stream

Special to NPN

PHILADELPHIA — A two-unit $29,500,000 Thermofor Catalytic Cracking plant at the Sun Oil Co.'s Marcus Hook (Pa.) refinery is now on stream, producing high octane aviation gasoline base stock for the armed forces, J. Howard Pew, president, announced on Dec. 4.

The new TCC units have a combined daily charging capacity of 20,000 barrels—840,000 gallons—and are integrated with other units at the refinery to increase still further Sun Oil's large production of 100 octane-plus gasoline for aviation combat use.

Mr. Pew said the new units, like other facilities Sun Oil has built to maximize production of war products, were financed entirely by the company. The cost was approximately $4,000,000, exclusive of existing utilities and facilities, which, if they had to be built, would have cost $1,300,000.

Construction of the new units required nearly 50 miles of pipes and tubes, ranging in size from a fraction of an inch to 42 inches in diameter; 3,720,000 pounds of steel in the structure and an additional 1,940,000 pounds in equipment; 2825 valves; 2700 flanges, and $125,000 worth of instruments. In operation, the units circulate 990,000 gallons of water and 200 tons of catalyst every hour, 24 hours a day.

The units are as tall as a 20-story building, and were built largely by Sun Oil's own refinery construction department with the assistance of E. B. Badger & Sons Co., Boston. Houdry Process Corp. is the licensor.

In a message to employes, Mr. Pew emphasized that completion of Sun Oil's wartime refinery construction program does not mean the war job is done.

"The fact that we have finished the last unit in our program of war projects simply means that all the tools we have scheduled are now in your hands for doing a superb job of production for war," he said. "I urge that you continue your good work to the end that even our present excellent record will be surpassed."

Reporting on Sun Oil's war job, Mr. Pew itemized the $29,500,000 expenditure for new facilities to produce military-specification products as follows:

Conversion of refinery units to produce aviation gasoline, $5,000,000.

Construction of a new aviation gasoline plant centered around the Houdry Catalytic Cracking Process and including the largest hydrogen fluoride alkylation plant in the world, $13,500,000.

Construction of a large, 4-unit aviation lubricating oil plant, $7,000,000.

Construction of the new twin TCC units, $4,000,000.

In addition to the above items of new construction, previously constructed facilities representing an investment in the neighborhood of $35,000,000 are devoted to the production of war products, making in all an investment of approximately $65,000,000 of Sun Oil Co. funds in facilities producing war products.

Egloff Reviews Wartime Oil Chemistry Gains

NPN News Bureau

LOS ANGELES—There should be no basis for concern about raw materials, as we will have ample oil supplies for many, many years to come, Dr. Gustav Egloff, director of research, Universal Oil Products Co., Chicago, told the Los Angeles section of the American Chemical Society on Dec. 1.

Dr. Egloff said petroleum refining was becoming more and more a chemical industry and reviewed marked acceleration in development of chemical processes in petroleum refining brought about by the stimulus of the present war.

Striking examples of quick changes in the industry, he said, are the increased production of aviation fuel and synthetic rubbers. Prior to the entrance of the United States into the war, Dr. Egloff said, 100-octane aviation fuel production was about 40,000 b/d, amounting to not more than 0.5% of the crude oil produced.

Production on July 1 was 500,000 b/d of 100-plus-octane gasoline, or more than 11% of our crude production. Predictions are that by the end of the year 15% of the crude production will be converted to aviation fuel.

On the subject of synthetic rubber, Dr. Egloff said that the synthetic rubber industry had jumped from a few thousand tons a year to over a million capacity rate by the end of 1944, at an installation cost of $730,000,000.

He said one company had produced more than 12,000 synthetic rubbers, of which about 2000 will have important postwar uses. Natural rubber he said, was not entirely satisfactory for modern needs, but must also be broken down and resynthesized. Natural rubber will be largely supplanted by synthetic products, just as indigo from plants has been replaced by the synthetic dye, and as the silkworm is succumbing to nylon, he said.

However, Dr. Egloff told his hearers, these chemical derivatives despite their impressive tonnage, represent in reality a very small percentage of the total oil and gas production.

"The United States produced 800,000 tons of chemicals from coal tar in 1940, and 1,800,000 tons from petroleum and other non-coal tar materials. The latter tonnage would represent 0.7% of 1944 crude oil production and 0.5% by weight of the total petroleum and natural gas. The hydrocarbons produced from oil and gas for synthetic rubber manufacture in 1944 will represent about 0.2% of the petroleum production", Dr. Egloff said.

Colonial Beacon Refinery Wins Top Safety Honor

NPN News Bureau

NEW YORK—The Everett refinery of Colonial Beacon Oil Co., New England affiliate of Standard Oil Co. (N. J.), was last week awarded the highest industrial safety award given by the National Safety Council "for Distinguished Service to the Cause of Safety."

The award cited the refinery's record of 1008 consecutive days without a single lost-time accident.

The record achieved was attributed in part of the refinery's system of frequent rotating of employe membership of its safety committee, so that over a period of years many employes had qualified as safety inspectors. The same system is now being adopted by other refineries affiliated with the Jersey company.

Orders Union Maintenance

Special to NPN

DALLAS, Tex.—The Eighth Regional War Labor Board here has ordered a standard "voluntary" maintenance of membership clause in the contract between the Oil Workers International Union (C.I.O.), Local 228, and the Port Neches plant of The Texas Co.

WHAT WILL 1945 MEAN IN THE HISTORY OF YOUR COMPANY?

A Challenge and an Invitation

★

1945—less than a month away—will go down in history as one of the most significant years in American business.

It will mark the start of the post-war period, the beginning of a new and enlightened era in merchandising.

It will put to the test the vision, skill and resourcefulness of every executive charged with the formulation and prosecution of sales and service plans.

It will establish new leaders in every field of activity.

★ ★ ★

What does 1945 hold for you?

The answer lies in the soundness of your plans, the speed with which they are placed in operation and the manner in which they are *keyed to realities.*

The realities, as we see them, are these:

Post-War consumption of gasoline by passenger cars will be LESS than pre-war consumption — because of the retirement of more old cars and the development of new models using less fuel per mile.

Overall consumption of fuels and lubricants will reach new heights because of (1) extraordinary development in the use of trucks, busses, tractors, farm equipment, civilian airplanes, production line equipment, heavy machines, household appliances—in brief, every type of product that involves moving parts, and (2) a new war-born conception of the value of conservation on the part of those who own and operate these units.

Thus, if an oil marketing executive is to key his plans to realities, he must base them on a realistic conception of the market and its characteristics. While fighting for passenger-car gasoline business, he must train his dealers to a new degree of effectiveness in developing lubrication, accessory and tune-up business. More than ever before, they must practice BALANCED SELLING.

On their part, jobbers and oil companies must pursue a relentless policy of pushing *all* phases of their market. Only in this way can they cash in their *overall* sales potentials.

★ ★ ★

AN INVITATION. We are a service company of 60 persons dedicated to the one job of assisting oil marketers in their sales and service problems. We are in contact with automotive, aviation and machinery manufacturers throughout the country. Immediately available, or in preparation, are programs covering every phase of your overall market—practical, hard-hitting programs designed to add authority, life and power to your own plans (see panel at right). We are already working closely with an Impressive group of the country's leading oil marketers. If you are a jobber, we suggest that you ask your supplying oil company about CHEK-CHART services. If you are an oil company executive, your inquiry will be our invitation to explain our expanded facilities and their relationship to your 1945 plans. Above all, we urge immediate action. From a standpoint of action, Post-War is NOW!

COOPERATION
IN ALL PHASES OF YOUR OWN COMPLETE AND WELL BALANCED SALES-SERVICE PROGRAM

TRAINING COURSES
"Service Man's Guide to Automotive Lubrication" (with Question and Answer Training Course)
"I Listened and Learned"

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CHEK-CHART Automotive Lubrication Guide
CHEK-CHART Wall Charts

ACCESSORY PROGRAM
CHEXALL Accessory Manual (including tune-up data)
Pocket CHEXALL

FARM MARKET
CHEK-CHART Tractor Lubrication Program
Truck and Tractor Booklets

TRUCK FLEET MARKET
CHEK-CHART Truck Lubrication Program

AVIATION MARKET
CHEK-CHART Aviation Lubrication Charts

PUBLICATIONS
Service Bulletin (monthly)
Tractor Digest (quarterly)
A. B. E. Bulletins
Special Bulletins

In preparation—programs covering farm equipment, industrial equipment, production line equipment.

All CHEK-CHART services are available either in Syndicated or Semi-Special form or custom-built to individual requirements.

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Gasoline from Methane Termed Rich Market For Unused Texas Gas

Special to NPN

AUSTIN—A new process for converting methane gas into gasoline has been described by Texas Railroad Commissioner Ernest O. Thompson as a boon to Texas property owners with natural gas on their lands.

The process, he said, will make dry gas worth around 10 cents per thousand cubic feet at the well, which he said would make a gas well as valuable as an oiler. Best prices in Texas at the present are around 5 cents.

Col. Thompson displayed a sample of the gasoline on his return from Olean, N. Y., and said it was made from methane by a process developed by C. F. Keith, a native Texan.

"Methane is what is left after the liquid hydrocarbons like butane and propane have been extracted from the natural gas," he said.

No Market Now for Some Gas

"It is said that the meat packer saves everything from the pig but the squeal. Methane is the squeal of the pig. This process uses the squeal of the gas—the skim milk.

"Some gas wells in Texas are closed in because they have no market. Gas has been selling for as little as one cent a thousand. Now with this process, a demonstrated success—gas becomes worth perhaps 10 cents a thousand at the well."

The Railroad Commissioner said that a plant using 64,000,000 cubic feet of methane per day will produce about 6000 barrels of 83 octane gasoline daily—roughly one barrel of gasoline from each 10,000 feet of dry gas.

"These plants can be erected in Texas at the gas fields. This will provide outlets for gas in fields that do not have pipeline connections.

"This means that with gas having a real value at the well, conservation will be made easier. Conservation will be more effective as the thing sought to be conserved becomes more valuable to its owners—self interest comes into play.

"It is difficult to get people to conserve something that has no sale value.

"As a conservation official this means more effective results in gas and oil conservation and waste prevention. It is a great boon to Texas."

Arabian-American Pushing 50,000 b/d Refinery

NPN News Bureau

WASHINGTON—The Arabian-American Oil Co. now expects to complete construction of its new 50,000 b/d refinery at Ras Tanura by next summer or fall.

Actual completion date will depend on availability of transportation for movement of materials and equipment. Already, however, the company has about 500 American construction workers on the job and expects to increase this number to around 1100 when work is under way full blast.

According to information here, the entire crude requirements of not only the Ras Tanura plant but also the company's present 200 b/d Arabian refinery and the 57,500 b/d refinery of Bahrein Petroleum Co. in Bahrein Island could be supplied, if necessary, from the 27 wells now producing for Arabian-American in the Damman Field. Present production apparently is only about 40,000 b/d, including 35,000 for barging to Bahrein Island refinery.

Production operations during present year have been limited to finishing of two wells—one a wildcat at the northern edge of the concession near the Kuwait border which turned out a "duster"; to rigging in another wildcat 12 miles north of the Damman field, and to rehabilitating wells which had been plugged in during the war period. The other well completed was in the Abqaiq field, making a total of five for that field. Wells being rehabilitated are expected to be back in production by the end of '44.

Word in industry circles here is that company's relations with government of King Ibn Saud "couldn't be more harmonious" than they are now, leading to supposition that company officials have no fear that concessions are in any danger of cancellation.

Orders Texas Butane Dealers Observe Safety Rules

Special to NPN

AUSTIN, Tex.—The state of Texas emerged victor, at least for the present, in its campaign to enforce safety measures when Judge J. Harris Gardner of 53rd District Court here issued temporary restraining orders against eight East Texas butane gas dealers.

Acting for the Texas Railroad Commission, the request for the orders was made by Assistant Attorney General Lattimore. The orders prohibit storage of butane gas in tanks not in accord with Texas statutes and Texas Railroad Commission regulations.

Those restrained were P. W. Norris, Luther J. Raley, C. A. Green and W. C. Smith, all of Tyler; Lee Wright, Chandler; Claude Williamson, Longview; E. D. Lockey, Jr., Troup, and Hugh D. Wood, Bronson.

Hearings were set Dec. 9 by Judge Gardner to determine if temporary injunctions should be issued. Commissioner Beauford Jester said other restraining orders would be sought in court.

Mr. Jester declared that highway patrolmen and commission inspectors were making investigations of hazardous conditions of butane systems in all parts of the state.

He charged that inconsistence of the War Production Board in granting applications to purchase butane systems had caused irregularities in types of butane tanks offered for sale, and that some changes in Texas laws were needed to cope with the situation.

Gulf Coast Refiners Boost Production 23,872 b/d in Year

Special to NPN

HOUSTON—Gulf Coast refiners are maintaining the high rate of operations that have marked the past few months, a report of the Gulf Coast Refiners' Assn. shows.

According to G. C. R. A. figures, crude runs were 87.7% of rated operating capacity and represent an increase of 23,872 b/d in comparison with operations at 81.4 per cent of capacity a year ago when the group processed 98,900 b/d. Two years ago crude runs were 87,468 barrels daily.

The Association's report covered operations for the first half of November.

Total stocks of all products in the plants of the association group were reported at 4,106,114 barrels on Nov. 15, showing a decrease of 120,407 barrels during the first half of the month. A year ago total product stocks were 3,425,955 barrels while stocks of all products at this time two years ago were 5,725,673 barrels and were then considered about normal for that time of the year.

Gasoline, Naphthas Decrease

Stocks of all grades of gasoline and naphthas decreased during the first half of November by 45,460 barrels and were reported at 1,544,365 barrels.

Automotive gasoline stocks alone were 576,498 barrels on Nov. 15, showing an increase since Nov. 1 of 51,918 barrels.

Kerosine stocks at 204,552 barrels Nov. 15 indicated an increase of 13,975 barrels. Diesel gas oil stocks were 222,464 barrels, reflecting an increase of 70,791 barrels. Stocks of other grades of gas oil decreased 64,602 barrels to 1,056,877 barrels on Nov. 15.

Stocks of heavier fuel oils decreased. No. 5 fuel oil decreased 33,489 barrels and Bunker C fuel oil decreased 61,622 barrels to 468,580 barrels on Nov. 15.

Debate California Fuel Oil Shortage in War Housing

NPN News Bureau

LOS ANGELES — PAW officials, oil refiners, and distributors of heating oil met here last week to discuss current problems in home heating.

Industry spokesmen, primarily concerned with heating conditions in large war housing centers such as Long Beach and El Segundo, pointed out that there is a short supply of fuel oil and an insufficient number of small distributors, which is made worse by small storage facilities at the Federal housing projects.

Refiners said that the supply situation was not critical and that if a distribution setup could be worked out there should be no serious home heating condition in this area. It will be necessary, it was pointed out, to cut into inventories of fuel oil to help ease the situation.

FACTS... About Postwar Refinery Economics

IT IS NOW virtually certain that immediately after the war competition will be severe. Consumers will demand improved quality in petroleum products. To meet all these overall market characteristics, M.W. Kellogg has already undertaken projects for the modernization of existing refineries to achieve specific objectives.

1. *With manufacturing costs lower than those for his prewar gasoline,* one Kellogg customer will increase his gasoline to 80-85 octane with less than 1 c.c. of lead.

2. Another Kellogg customer, whose distillates already meet postwar quality requirements, will produce 20% more of these profitable products—20% less of unprofitable residual oils—*with no increase in the total refining cost of finished products.*

THESE specific objectives of our customers are not inspired by the realm of theory. The process concepts to achieve them are commercially practical—proven in the Kellogg "pilot" refinery and now being finally engineered. Such projects, already under way, are a measure of the competitive "plus" that an M. W. Kellogg job can give to *any* refiner... regardless of the size of his operation.

THE M. W. KELLOGG COMPANY

★Only Kellogg Service Has Them All

★**LABORATORIES**—fully equipped and staffed—devoted exclusively to chemical engineering and process development.

★**24-HOUR-A-DAY PILOT PLANTS**—17 refining processes operating continuously—providing accurate data for commercial scale application.

★**EXCLUSIVE CHEMICAL ENGINEERING DATA**—Continuously compiled . . . embracing both pilot plant runs and the operation of Kellogg-built refineries. Data extends from beginning of modern refining.

★**PROCESS ENGINEERS**—Specialists who have continuously made major contributions to oil refining development, for more than 20 years . . . currently exemplified by their work on fluid catalytic-cracking.

★**MECHANICAL ENGINEERS**—Kellogg installations—worth hundreds of millions—are their best reference.

★**METALLURGICAL LABORATORY**—Establishes continuous check of specifications...creates new techniques for the fabrication of refining equipment.

★**PERMANENT CONSTRUCTION CREWS**—Geared to function all over the world on single units or multiphase refineries . . . team-experience cuts costs, speeds construction.

★**OPERATING STAFFS**—Specialists at placing new units "on stream" . . . training of refiner's own operating crews.

★**LICENSING SERVICE**—Licenses available through Kellogg as Licensor or licensing agent for all types of refining processes.

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Kansas U. Foundation Donates Oil Patents

Special to NPN

LAWRENCE, Kans.—The University of Kansas Research Foundation will turn over to the public all its patent rights on a process for the exclusion of water from oil wells by injection into the water bearing portion of the formation, Dr. Eugene A. Stephenson, executive director of the Foundation has announced.

Dr. Stephenson, who developed and patented the process, donated all his rights to the foundation. That organization in turn will make the method available to the oil industry with no charge.

Three oil companies, Phillips, Cities Service, and Stanolind, which financed part of the research, already have licenses to use the process. These companies have assigned all their rights, except shop rights, to the foundation with the understanding that they shall forever have the use of the process in their own wells without charge.

"Dr. Stephenson and the research foundation have made this new process available to the oil industry" said Chancellor Deane W. Malott, "because they believe that the process will aid in exclusion of salt water from oil wells and thereby tend to prevent stream pollution, reduce operating costs generally, and in the long run increase the ultimate production of oil. The university, as a part of the state of Kansas, is concerned with the conservation of the State's natural resources."

The foundation was recently incorporated, and turning over the patent rights was one of its first acts.

East Texas Operators To Face Hearing on River Pollution

Special to NPN

DALLAS, Tex.—Charging that a court injunction against polluting the Angelina River in East Texas had been violated, the state has asked a district court here to hold the oil operators in contempt of court.

The operators, Sam Roosth and A. S. Genecov of the Roosth & Genecov Production Co., Tyler, were under temporary injunction granted by Judge John A. Rawlins on Sept. 13, 1943. Attorney General Grover Sellers charged that the order had been violated, and Judge Rawlins set a hearing for Jan. 2.

Resolution for Probe of Natural Gas Approved In Surprise Action by Senate Committee

NPN News Bureau

WASHINGTON—In a surprise action, the Senate Interstate Commerce Committee this week approved and recommended Senate adoption of the Overton resolution (S.J. Res. 92) which would authorize the Federal Power Commission to undertake a comprehensive investigation into the production, distribution, sale and use as well as transportation of natural gas.

The inquiry, which goes beyond the scope of the investigation launched by FPC Sept. 22 on its own motion, is intended to provide the basis for future legislation supporting apparent commission efforts to prevent use of natural gas as a boiler fuel.

Oil men, as well as the natural gas industry, have expressed opposition to the resolution on the grounds that the commission wants to control the flow of gas all the way from the bottom of the well to the burner tip and that this inevitably means Federal control of oil production, too.

House Group Still to Act

The resolution had languished in committee for several months after having been approved by a subcommittee. Whether it can be passed at this session of Congress appears doubtful, however, inasmuch as the House Interstate Commerce Committee has not yet acted on a companion resolution (H.J. Res. 181) and has a full schedule which likely will preclude consideration.

Changes made by the Senate committee in reporting S.J. Res. 92 included an authorizing or appropriation of $100,000 instead of only $30,000 as had been proposed, to FPC to finance investigations. Others would give FPC a year instead of six months in which to make a final report to Congress; extend from 90 days to six months the deadline for filing of an interim report, and direct FPC, "so far as practicable," to avail itself of services and records of the Bureau of Mines, Geological Survey, other government agencies, the "appropriate agencies of the several states," and the Interstate Oil Compact Commission in making its study.

The latter amendment is aimed at meeting an objection voiced by Secretary Ickes that much of the information sought by FPC has already been assembled.

Scope of Inquiry Limited

The resolution delimits the scope of investigation by stating that FPC shall "inquire into and report to the Congress" with respect to the following matters:

"(a) The extent, location, and availability of the known natural gas reserves in the United States, and the effects of the present and anticipated depletion thereof;

"(b) The nature, amount, and location of the present and anticipated utilization of natural gas, the resultant economic waste and undesirable competition with and displacement of other fuels, and the feasibility of converting natural gas and its constituent hydrocarbons for chemical and other superior uses; and

"(c) Such other matters relating to the production, transportation, distribution, sale, utilization of natural gas as may be helpful to the Congress in determining what additional legislation, if any, should be enacted for the purpose of restricting unnecessary waste or depletion of natural gas reserves or the utilization of natural gas for inferior or otherwise undesirable purposes in competition with other fuels."

Rig Builders Given Warning On Wage Stabilization

Special to NPN

DALLAS—Representatives of the oil rig building industry were called on the carpet here by A. Langley Coffee, regional War Labor Board attorney, for a discussion of his memorandum concerning alleged violations of the "wage stabilization code."

Mr. Coffee said that in a prior note to the rig builders, he had pointed out that "certain contractors" had inaugurated unstabilizing wage practices, in many instances making unauthorized salary adjustments without WLB approval. (*See Hadlick article, p.* 50)

Subjects under discussion at the conference, he said, were rates of pay, premium and overtime pay, travel time, union contracts and working rules, and penalties for violations and enforcement of the wage stabilization code.

Crude Stocks Up 529,000 Bbls.

NPN News Bureau

WASHINGTON — Domestic and foreign crude petroleum stocks at the close of the week ended Nov. 25 totaled 221,960,000 bbls. up 529,000 bbls. over the previous week, the Bureau of Mines announced this week.

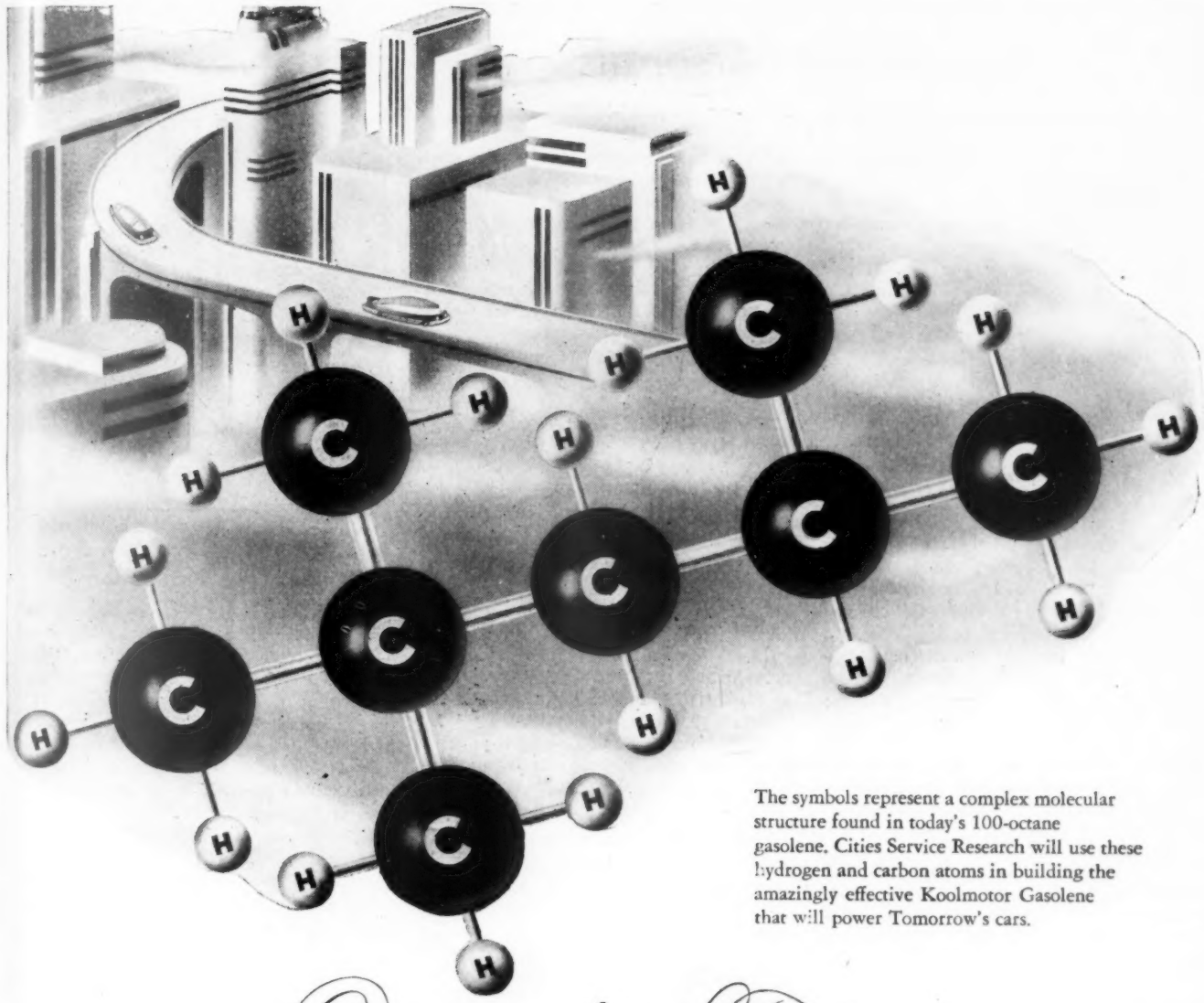
There was an increase of 780,000 bbls. in stocks of domestic crude and a decrease of 251,000 bbls. in stocks of foreign crude. Heavy crude-oil stocks in California, not included in the gasoline-bearing stocks, totaled 6,663,000 bbls., up 6000 bbls. from the previous week.

Major increases were California, up 477,000 bbls.; Texas, up 131,000 bbls.; and Oklahoma, up 295,000 bbls.

Other major decreases were Kansas, 123,000 bbls.; Louisiana, 162,000 bbls.

December Sour Gas Quota Set

AUSTIN—December gas allowables in the big Panhandle sour gas fields will be 721,536,000 cubic feet daily, the Railroad Commission has ruled.



The symbols represent a complex molecular structure found in today's 100-octane gasolene. Cities Service Research will use these hydrogen and carbon atoms in building the amazingly effective Koolmotor Gasolene that will power Tomorrow's cars.

Design for Tomorrow

PETROLEUM—Bloodstream of War—will be a vital Bloodstream of Peace. In the Cities Service Research Laboratories, work has been done on many new products, new processes, new devices. Some are "hush-hush". Others are ready and waiting for developments in the automotive and other industries—developments which can come only *after* Victory is won.

Cities Service stands ready *now* to "service" your car of the future. Sounds incredible? Then let us prove it.

Before new models even reach the blueprint stage, our research people are in consultation with the automobile manufacturers, checking on the fuels and lubricants they will need. And so flexible are the ultra-modern facilities of the great new Tutwiler Refinery at Lake Charles, Louisiana, that we are ready at a moment's notice to meet the exacting demands of tomorrow's engines.

And so out of research, our specialists have been able to develop high-powered, high-octane gasolene — temperature-resisting lubricants — waterless soap, fuel-saving devices, new plastics and countless petroleum derivatives.

One thing is sure . . . you can look to Cities Service for important new developments after the war.

Progress through Service—

CITIES SERVICE

Equipment Personals

Mr. Reagan

J. E. Reagan was appointed director of sales and service of Elco Lubricant Corp., Cleveland, as of Oct. 1, a recent announcement from **J. R. Heller,** vice president and general manager of Elco, states. Mr. Reagan was general service manager of the Timken Roller Bearing Co. for many years.

* * *

Vice President W. C. Stolk of the American Can Co. has announced that **Dr. Roger H. Lueck** has returned to the company's Pacific division to become manager of sales. Dr. Lueck has been in the general sales department of Canco in New York, planning postwar projects. He was the first manager of the company's San Francisco laboratory. Later he became general manager of Canco operations in Hawaii, after which he became director of research with headquarters at the Maywood, Ill., laboratories.

* * *

P. S. Dickey has been appointed chief engineer of the Bailey Meter Co., Cleveland. Mr. Dickey will supervise all engineering, research and design activities for the company. He will be assisted by **H. H. Gorrie,** assistant chief engineer, and **R. E. Clark,** manager of contract engineering.

Mr. Dickey is a mechanical engineering graduate from Purdue University. He has served Bailey Meter Co. continuously in various engineering capacities since his graduation in 1925.

* * *

E. M. Martin of the B. F. Goodrich Co., is now in Europe as a member of a special Anglo-American-French mission to make recommendations on the restoration of the rubber industry and the re-establishment of civilian transport in France.

Mr. Martin has been on loan from Goodrich as special assistant to the administrator of surplus war goods and later with WPB in Washington.

* * *

Frank Jardine, who has been in charge of development work in Cleveland for the Aluminum Co. of America, has been given the title of Manager of the Development Division, Cleveland branch. Mr. Jardine has been with Alcoa since 1918. During that period he has been active in sales engineering and sales development for aluminum products. With a corps of engineers, Mr. Jardine will give special emphasis to the automotive and general internal combustion engine field.

Other sales engineering and development division activities of Alcoa, includes the placing of **John R. Willard** in charge of the sales development division at New Kensington, Pa., and the appointment of **B. J. Fletcher** as chief engineer of the New Kensington branch. Messrs. Willard and Fletcher with their associate engineers will assist users of aluminum in many fields, including petroleum.

* * *

George Hamm, manager of the Kansas City district of the Industrial Products Sales Division of the B. F. Goodrich Co., was recently presented with a 40-year pin by E. F. Tomlinson, division general manager. Mr. Hamm's service has been continuous with the exception of time spent in the army during World War I.

* * *

James M. Robbins of the B. F. Goodrich Co. is now in the Colombian capital as Goodrich technical representative on the staff of the new Colombian Tire Co. in Bogota, S. A. The Colombian plant, now nearing completion will produce tires and tubes early next year.

* * *

J. F. Deitz, formerly regional manager of Gilbert & Barker Mfg. Co., has been advanced to assistant sales manager, **W. C. Leitch,** Gilbarco sales manager, has announced.

Mr. Deitz

Mr. Deitz for 29 years has held various positions in the sales department of that company. For 10 years he was supervisor of the sales department. He is a member of the Springfield, Mass., Sales Managers Club, and the National Federation of sales executives.

Promotion of **K. S. Edwards** and **R. B. White** was also announced. Mr. Edwards becomes sales promotion manager, while Mr. White becomes advertising manager.

Mr. Edwards joined Gilbert & Barker 25 years ago as a salesman. He served as an officer in World War I.

Mr. White, a Gilbarco employe since 1927, was made advertising supervisor five years ago. He is a member of the Board of Directors of the Springfield Advertising Club, and of the Springfield Better Business Bureau.

* * *

Oscar M. Havekotte, Columbus, O., has been elected a director of Dresser Industries, Inc., President **H. N. Mallon** has announced. Mr. Havekotte, for the past four years president of International-Stacy Corp. and of International Derrick and Equipment Co., both Columbus concerns, will continue as head of the latter company.

* * *

Mr. Tongue

Arthur E. Tongue has been appointed manager of antifreeze sales for U.S. Industrial Chemicals, Inc. He will be in charge of the sale of U.S.I.'s Super-Pyro Anti-Freeze, as well as its other automotive products.

Mr. Tongue comes to U.S.I. from the Chrysler Corp., where, for the last eight years, he was in charge of advertising and sales promotion.

Big Texas Rubber Plant Equals 14-Million-Tree Production

Special to NPN

PORT NECHES, Tex.—Operated with a record total of 1,000,000 man hours without a lost time accident for any of its personnel, "Rubber Rancho Grande," the government synthetic rubber plant here, operated by the B. F. Goodrich Co., produced 100,000,000 pounds of man-made rubber up to Nov. 5, company officials announced.

The output of "Rancho Grande" in slightly more than 14 months is equivalent to the rubber yield of approximately 14,000,000 rubber trees in the same period, it was said.

Dresser Moves to Cleveland

NPN News Bureau

CLEVELAND — Dresser Industries, Inc., will move its headquarters from Bradford, Pa., to Cleveland, O., H. N. Mallon, president, announces. Executive offices will be in the Terminal Tower.

Cleveland already is the home of a Dresser Industries' member company, the Bryant Heater Co., and of an affiliate, Van der Horst Corp. of America. Dresser Industries, Inc. is the parent corporation of a group now comprising 10 companies, all in related lines of manufacture of equipment for the oil, gas and other industrial fields.

Buy Oklahoma Gas Equipment

NPN News Bureau

TULSA—Equipment and franchises in five towns in north central Oklahoma have been acquired by Consolidated Gas Utilities Corp. from Oklahoma Natural Gas Co., to become effective Dec. 1. Consideration was given as "approximately $30,000." Towns involved are Deer Creek, Pond Creek, Nardin, Hunter and Lamont. Properties are on Consolidated's trunk pipeline system. Consolidated has been selling natural gas to Oklahoma Natural.

FROM MIAMI TO THE HIMALAYAS

Peacetime or wartime, in modern Miami or the remote Himalayas, Pan American World Airways can't take chances on fueling systems—for fuel must always be kept clean, dry, safe! Fueling equipment must be sturdy, dependable, accurate.

It's significant, then, that Pan American depends so widely on Bowser fueling units at its bases both here and overseas. Pan American Clippers are today flying the Pacific route to Hawaii and the Atlantic route clear to the Far East. Many bases are in desolate, remote areas where dependability and accuracy of equipment, incalculably important even in peacetime, are still more vital today.

That's why, of course, Pan American has chosen Bowser.

Dependability and accuracy, plus time and labor saving . . . that's why, too, Bowser equipment—bulk plant and truck meters, pumps, barrel and can filling equipment, etc.—has taken such a dominating place in the petroleum distributing industry.

Here are a few typical quotations from distributors regarding Xacto Meter, one of the many Bowser units on which they depend:

"After installing this unit, I have cut my shrinkage about 50%, which has paid for my Xacto Meter many times over."—"Before I had my Xacto Meter, it took two men about one hour (for a certain job). Now it takes about half an hour for one man. Before I had two trucks. Now I have only one and get around just as fast."—"It surely is a wonderful time and labor saver, also a business getter."

And remember this—wherever you are, there's a complete Bowser service organization close to you. BOWSER, INC., Fort Wayne 2, Indiana.

PAN AMERICAN WORLD AIRWAYS DEPENDS ON BOWSER FUELING EQUIPMENT

—Pan American World Airways Photo

End of the aerial Burma Road—This plane, refueling after bringing a load of vital supplies over the Himalayas, is in the fleet of China National Aviation Corp., Pan American's affiliate in the Orient. This desolate setting is typical of the extremes in which Bowser Fueling Systems are working to help keep air transport operating.

BOWSER ESTABLISHED 1885

THE NAME THAT MEANS **EXACT CONTROL** OF LIQUIDS

Not only has Bowser's war production earned the Army-Navy E . . . Bowser equipment has helped win it for scores of other companies.

BUY WAR BONDS

PROTECT YOUR TANKS AND TANK CONTENTS WITH *New Style*

OCECO GAUGE HATCHES

Easy to Operate . . . Non-Sparking and Positively Gas-Tight Closing, they Repay their Cost through Savings

● Good gas-tight tanks are expensive, and their contents even more so. But tanks are not tight, nor their contents safe, unless the gauge hatches are designed and built to maintain gas-tightness. Specify Oceco Gauge Hatches. They have been tested and approved by Underwriters' Laboratories, Inc.

Oceco Hatches are opened easily by pressing straight downward on the foot treadle (see view above) thus avoiding the danger and awkwardness of operating a vertical pedal. The hatches are self-closing, and are provided with a non-sparking composition ring set in the cover, that seats tightly against the narrow seating edge of the body, assuring positive spark-proof gas-tight closure—thus preventing any loss of volatiles through the hatch, and the resulting fire hazard. Oceco Hatches are furnished with steel plate flanges for welding or bolting to the tank roof—or threaded for pipe mounting. Prices, sizes, and complete description of standard, pressure type, stirrup-operated and other special designs sent on request. Write for Bulletin No. H-52.

OCECO

Division of

THE JOHNSTON & JENNINGS COMPANY

883 Addison Road · Cleveland, Ohio

Engineering and Sales Representatives in the Principal Cities

FIRE PREVENT'ON AND VAPOR CONSERVATION EQUIPMENT FOR VOLATILE LIQUID STORAGE TANKS

Standard of Jersey Broadens Employes' Benefit Plan

NPN News Bureau

NEW YORK—At least one year's salary or wages will be paid to beneficiaries of active employes of Standard Oil Co. (N. J.) who have had service of five years or more, the company announced last week in reporting changes in its disability and death benefit plan. For each year's service after five, the beneficiary may receive an additional half month's pay in death benefit. After 17 years' service the death benefit would be equivalent to 1½ years normal earnings and at 29 years would equal two years' pay.

The company maintains the plan without contribution from its employes. It formerly provided for a death benefit equivalent to one year's salary for beneficiaries of employes with ten or more years of service and gave beneficiaries of employes with five to ten years of service pay up to $3000. Under the present plan, the $3000 limit has been removed and at the same time provision has been made for increasing the death benefit to the equivalent of one year's salary for continued service.

A benefit proportionate to length of service is paid to beneficiaries of employes who have been with the company for less than five years beginning with the equivalent of three months' earnings at the end of the first year.

The plan also includes accident and sickness benefits. It does not affect group insurance through which employes who subscribe may provide approximately an additional year's salary for their beneficiaries.

100th 'Superior Farmer' Is Given W. G. Skelly Award

NPN News Bureau

TULSA—The 100th W. G. Skelly award for superior achievement in agriculture was made on Nov. 25, to a Sedalia, Mo. farmer.

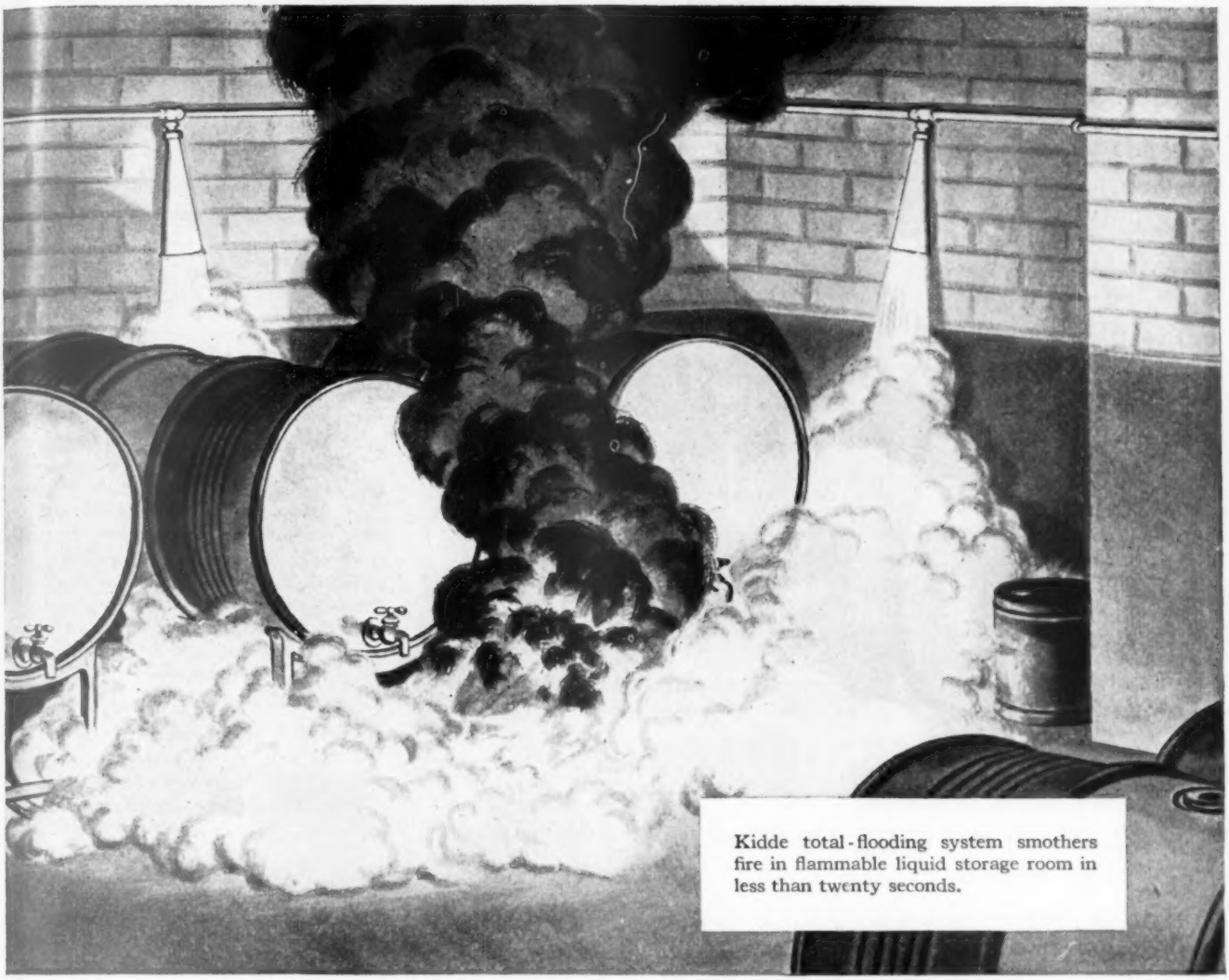
Awards are announced by radio every Saturday morning to midwestern farmers who are doing a superior job in producing food. Factors, such as soil conservation and erosion control measures, a farmer's ingenuity in overcoming machinery and labor shortages, his community leadership and his all-around superior achievement in the field of agriculture enter into selection.

Farmers are nominated by friends, neighbors and farm leaders. A special award committee consisting of 11 outstanding Midwest farm or extension service leaders selects the farmer with the best record to receive the honor. The award is a $100 War Bond, a scroll, pennant and gold lapel button.

Mr. Skelly has announced that the program will be continued in 1945.

Oklahoma Tax Take Is Higher

OKLAHOMA CITY — Oklahoma Tax Commission collections for October totaled $5,082,734.29, an increase of $337,160.33 or 7.1% over October, 1943.



Kidde total-flooding system smothers fire in flammable liquid storage room in less than twenty seconds.

BEFORE TOUGH FIRES GET TOO TOUGH

. . . *blast them out with Kidde!*

In fighting the tough gasoline and oil fires you've got to smother them *fast* before they spread beyond control.

That's one of the jobs for which Kidde equipment is designed — and specifically approved by Underwriters. Clean, dry, inert carbon dioxide, released under high pressure, snuffs out the blaze in a matter of seconds, leaving no after-fire mess to be cleaned up . . . keeping petroleum products free from contamination, dilution or other damage.

Kidde built-in systems, employing this fast, safe fire-killing agent, can be engineered to control a fire hazard automatically, by flooding it with carbon dioxide. And Kidde equipment is equally effective for extinguishing fires that break out in your electrical equipment — for it carries all laboratories' approval for *both* flammable liquid (Class B) and electrical (Class C) fires.

Check this list today. Does even *one* of these hazard areas need protection in your plant? If it does, call in a Kidde representative. He'll be glad to share his fire-prevention know-how with you. Write us today.

KIDDE KILLS TOUGH FIRES

- Storage Rooms
- Pump Rooms
- Tank Trucks
- Electrical Equipment
- Paint Storage
- Antifreeze Rooms
- Pipe line pumping stations
- Case and Can Rooms
- Control Rooms
- Laboratories
- Bulk Plants

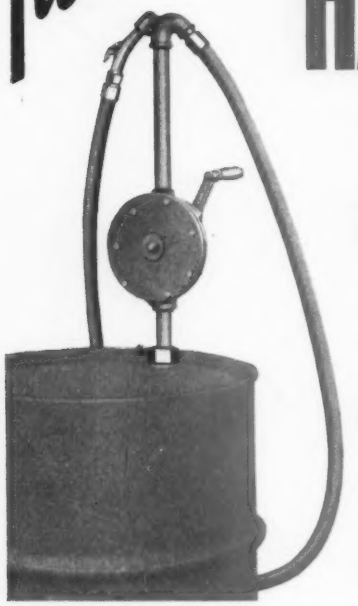
Walter Kidde & Company, Inc. • 140 Cedar Street • New York 6, N. Y.

Furnish

BLACKMER ROTARY HAND PUMPS

For Handling

TRACTOR FUEL KEROSENE MOTOR OILS



Complete Refueling Units

Help Your Customers SAVE THESE CRITICAL MATERIALS

BLACKMER HAND PUMPS ARE SELF-ADJUSTING FOR WEAR

20 Years of Constant Service is not Unusual

NO OTHER HAND PUMP HAS ALL OF THESE FEATURES!

- SELF PRIMING
- 20 FOOT SUCTION LIFT NO FOOT VALVE NEEDED
- STEADY, NON-PULSATING FLOW, EASY CRANKING
- PUMP ANYTHING FROM GASOLINE TO HEAVIEST OILS
- CAPACITIES 1 1/2 TO 25 GPM PRESSURES UP TO 125 PSI
- 56 MODELS - THE RIGHT PUMP FOR EVERY CUSTOMER

Standard Barrel Pump

Heavy duty Barrel Pump

Drip-proof Barrel Pump

Thousands of these pumps are in daily use on skid tanks and as dispensing pumps for farms and industrial plants.

Write for Bulletin No. 205— "Rotary Hand Pumps".

Blackmer Pump Co., 18812 Century Ave., Grand Rapids 9, Mich.

SERVING THE PETROLEUM INDUSTRY FOR 40 YEARS

BLACKMER Rotary PUMPS

"BUCKET DESIGN"—SELF-ADJUSTING FOR WEAR

Carter Workers To Receive New Thrift Plan Benefits

NPN News Bureau

TULSA — Approximately $3,800,000 will be distributed to employes of Carter Oil Co. and Oklahoma Pipe Line Co. as the result of additional contributions being made by the Standard Oil Co. (N. J.), and its affiliates, to increase credit balances in the employes' thrift plan.

Every employe participating in the plan will receive a credit of $25. The balance will be distributed on a proportional basis. Employes who have been granted special leave of absence for military service will share in this distribution.

Under the provisions of the employes' thrift plan any employe can authorize his employing company to withhold and assign to his credit in the fund not less than 3% nor more than 13% out of his pay envelope. The employing company adds to this payment dollar for dollar on the first 3% of the employe's earnings assigned to the fund, and 50 cents more for each dollar above the 3% minimum required for membership.

I.P.A.A. Publishes Pamphlet Analyzing Oil Compact

NPN News Bureau

TULSA—.Publication of a booklet on the Anglo-American Petroleum agreement by the Independent Petroleum Assn. of America has been announced by Ralph T. Zook, president of the association. Included in the booklet, in addition to the agreement, are texts of discussions by George A. Hill, Jr., of Houston, Tex., and Mr. Zook, both members of P.I.W.C. and of the National Oil Policy Committee and the production committee created thereunder; an address by Francis C. Wilson of Santa Fe, N. M., before the New Mexico Bar Assn., and the resolution opposing the agreement adopted by I.P.A.A.

Mid-Continent Assn. Opens New Mississippi Division

Special to NPN

JACKSON, Miss.—Headquarters have been established here at 508 Capital National Bank Bldg. for the newly formed Mississippi-Alabama division of the Mid-Continent Oil and Gas Assn.

Officers elected to head the new group include C. L. Morgan, independent operator and head of Dixie Geological Service, president; W. M. Vaughey, of Vaughey & Vaughey independent, operators, secretary. A board of 50 directors has been elected and a 15-man committee on committees chosen.

Two Quit Continental Can Co.

NPN News Bureau

NEW YORK—Carle C. Conway, board chairman and president of Continental Can Co., Inc., announced last week the resignations of Frank J. O'Brien and Eugene J. O'Connor, both vice presidents.

NEW HEIGHTS IN REFINING

Modern installations, of which this is typical, back the fulfillment of the Sinclair postwar program

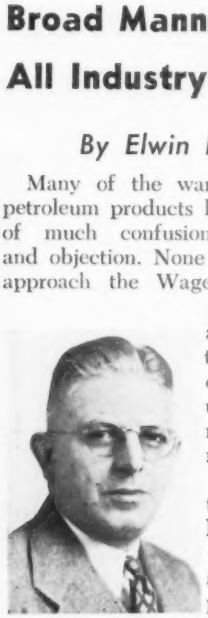
"BETTER PRODUCTS"
and
"BETTER SERVICE"

SINCLAIR

Broad Manner by Which Congress Tried To Cover All Industry Blamed in Wage-Hour Confusion

By Elwin E. Hadlick

Many of the war orders relating to petroleum products have been the cause of much confusion, misunderstanding and objection. None of those orders can approach the Wages and Hours Law (Fair Labor Standards Act of 1938) on the first two counts of confusion and misunderstanding. The reasons are probably many and varied.



Mr. Hadlick

An inquiry into the reasons underlying the manner in which these orders are received isn't particularly helpful. At the same time a normal amount of curiosity should be satisfied and a guess or two may be hazarded.

The principal cause for confusion is probably the broad manner in which Congress attempted to cover industry. The main reason for misunderstanding seems to be the inability or refusal of business men to follow the fine lines of demarcation caused by the language used by Congress. Finally, the objections are grounded primarily in the natural resentment at Governmental interference with the operation of private business in what appears to many to be an unnecessary field.

The subject of the Wages and Hours Law is important because all indications are that it will be on the statute books for many long years to come. That there is a necessity for writing on compliance features of this law is indicated not only from the questions which are being raised but from feelings of some Wage-Hour Division offices that the field of education has not been fully covered.

States Should Have Acted

In the June 21st issue of National Petroleum News this column was devoted to a discussion of the effect of the Wages and Hours Law on salaried service station operation. That survey did not exhaust the field of this law which, while short in itself, has been the subject of hundreds of pages of interpretation, explanation and court decision.

In the early stages of consideration of the regulation of wages and hours there was a strong feeling that the subject was one for individual state legislation. At the same time everyone seemed to concede that no single state could proceed on its own because of the resulting damage which its businesses would suffer in competition with businesses from other non-regulated states. There was therefore a feeling that here again was a field of regulation in which the Federal Government should take the lead, in order that each individual state could in turn enact state legislation to regulate the strictly intrastate commerce within its own borders.

If the individual states had followed in the footsteps of Congress by enacting state laws to regulate hours and wages in intrastate commerce in words identical to those used by Congress in its act the situation might be different. Employers would have been spared most of the necessity for having to determine whether or not a particular business or any employe thereof was engaged in interstate or other kind of commerce. Individual states did not generally follow the lead of Congress, with the result that many businessmen in many states find it necessary to determine whether particular employes are covered by the act.

It is not every business which raises a question of coverage under the Wages and Hours Act which can rightfully be accused of trying to chisel out of its normal or other obligations with respect to its employes. As a general thing the minimum wage rate is not a stumbling block.

In the accompanying article, Elwin E. Hadlick, Minneapolis attorney and marketing association executive, discusses some of the reasons for the confusion, misunderstanding and objections to the Wages and Hours Law. This is one of several articles that Mr. Hadlick plans to write on this subject which is of such vital interest to all oil industry employers. The article is the 38th in Mr. Hadlicks' war-oil compliance series.

There is no point to endeavoring to outline all of the situations in which one may raise a question without fear of being accused of being unfair to labor. As a typical example there is the case of the employer having a union agreement of years standing providing for overtime after 48 hours per week of work who faces the question of whether or not he is required under the law to start overtime at 40 hours. Then there is the case of the operator of a petroleum products bulk plant who pays a commission on sales to a tank wagon driver who owns his own truck and who operates as and when he sees fit.

If the law applies and overtime must be paid after 40 hours per week in the case of the union agreement, the employer must watch the basic rate closer than if the overtime starts at 48 hours. In the other case of the commission tank wagon driver effective controls over time and manner of performance will be necessary if the employer is bound to pay compensation after 40 hours at one and one-half times the hourly rate represented by the basic rate.

There have been some developments in the law and in the court decisions since enactment of the wages and hours legislation. The entire collection of data and documents which has been assembled during the period since legislation was first proposed to Congress has been carefully studied. It was amazing to find that an article which appeared in National Petroleum News on Dec. 18, 1940 still represented in the main the guiding principles for the distributor of petroleum products.

4 Orders Affect Industry

There has been some change in the minimum wage requirement and in the maximum work-week before application of overtime. The work-week has gradually been reduced by terms of the act until it is at the present time 40 hours per week. Overtime is now payable to employes covered by the act, in most instances, after 40 hours per week.

The minimum wage has been brought up from 25c per hour to a present level of 40c. Congress provided for a starting minimum rate of 25c per hour, with increases periodically until a minimum of 40c was reached. There was nevertheless provision whereby the Administrator of the Act could hurry along the date on which a higher minimum rate could be made effective. He was limited to a top of 40c. The Administrator has taken full advantage of the authority given to him by the Act and has, by means of 69 separate wage orders, provided a country-wide, industry-wide minimum rate of 40c.

These wage orders are important documents from a legal standpoint, but of little or no practical importance from the standpoint of determining whether and to what extent a particular business is covered by the statute. The petroleum industry is not treated in any single order but must consult four separate orders before learning the full extent to which a 40c minimum wage has been provided for it. These 69 wage orders are in almost identical terms except for the description of the industry or portion thereof to which they apply. They will not be further mentioned.

Considering the Law Itself

With that preliminary background, all necessary for a proper application of the law to any individual business, it is proper to now start to consider the law itself and its application to the petroleum industry. The language of Congress as to the coverage of the Act is broad, and yet it is different than the language found in many other acts relating either to inter-

state commerce or to problems of labor control. Congress provided that the act should apply to the employes of industries engaged in commerce or in the production of goods for commerce.

The words referred to in the preceding paragraph as being in the Congressional Act are not used to describe one set of circumstances but rather two separate and distinct situations. Congress intended first to make the law applicable to the employes of industries which are engaged in commerce.

Commerce Not Defined

Notice it did not say "interstate commerce" but just plain "commerce." Congress did go on to define "commerce" as meaning trade, commerce, transportation, transmission, or communication among the several states or from any state to any place outside thereof. Congress intended and did, secondly, provide that the Act should be applicable to employes who are engaged in the production of goods for commerce.

It is not particularly necessary to determine in any individual case whether an employer or an employe is covered by the act because engaged in commerce or because engaged in the production of goods for commerce; it is important that consideration of possible coverage be not determined on a consideration of only one of the features of commerce which Congress regulated by the Act.

The next logical approach is to the types of business which are subject to the act because engaged in commerce or in the production of goods for commerce. These will be considered in the next article.

Index of Week's War-Oil Orders

(Issued Nov. 25-Dec. 2, 1944)

OPA—Office of Price Administration

MPR 88, Official Correction Am. 20—Deletion of fuel oil prices for 3 Conn. towns.

Am. 21—Specific distillate ceilings in Metropolitan Chicago Area and Maine; L.P.G. ceilings in Corpus Christi, Texas Area; Midwest suppliers' ceilings to service station resellers.

Order 54—Allied Oil Co. fuel oil ceilings to Republic Steel Corp.

MPR 137, Am. 7—Puerto Rico retail kerosine ceilings.

RO 1A, Am. 90—Miscellaneous amendments to tire rationing regulations.

Am. 91—Transfer of tires.

RO 5C, Am. 164—Miscellaneous gasoline rationing amendments.

Am. 165—Certification of applicants under an organized transportation plan.

RO 9A, Am. 18—New stove-dealer applications.

Rev. RO 11, Am. 36—Fuel oil rations for commercial motor vehicles.

Am. 37—Surrender of evidences.

Am. 38—Dealer's time for filing statement extended to 12-31-44.

Duluth-Superior Order G-1—Statements required from registered dealers in Duluth-Superior District.

WPB—War Production Board

CMP 1, Direction 48 as am. 11-20-44—Purchases and sales of controlled materials by an intermediary and a reseller.

Pri. Reg. 13, as am. 11-22-44—Sales of frozen, idle, excess materials.

Pri. Reg. 24 as am. 11-21-44—Purchase of equipment for nonessential civilian production and services.

Pri. Reg. 25, Direction 1 as am. 11-21-44—WPB Orders covered by Pri. Reg. 25.

Direction 2—Use of Form WPB-4000.

Commissioner of Internal Revenue

Treasury Decision 5416—Procedure upon contravention of salary stabilization regulations.

ICC—Interstate Commerce Commission

2nd Revised SO 243—Light-weighing of tank cars.

Service Order 255—Overloading of freight cars.

Service Order 255-A—Vacation of Service Order 255.

ODT—Office of Defense Transportation.

GO ODT 7, Revised, Am. 2—200-mile minimum reinstated for movement of traffic in railway tank cars.

AO ODT 29—Delegation of authority.

FEA—Foreign Economic Administration

Gen. Regs., Am. 260—Prohibited exportations of chemical specialties.

Indiv. License Procedure, Am. 258—Period of validity of export licenses.

WFA—War Food Administration

WFO 46, Revocation—Pyrethrum insecticide restrictions revoked.

WFO 49, Revocation—Restrictions removed on agricultural uses of rotenone insecticide.

CODE: AO—Administrative Order; CMP—Controlled Materials Plan: D—Directive; FDO—Food Distribution Order: GMPR—General Maximum Price Regulation: GO—General Order: Interp.—Interpretation; L—Limitation Order; M—Conservation Order; MPR—Maximum Price Regulation; P—Preference Rating Order; PAO—Petroleum Administrative Order: Pri. Reg.—Priorities Regulation: Proc. Reg.—Procedural Regulation; PS—Price Schedule; RO—Ration Order; RPS—Revised Price Schedule; SO—Supplementary Order; SR—Supplementary Regulation.

Digest of Week's War-Oil Orders

Office of Price Administration

DELETION OF FUEL OIL PRICES FOR 3 CONNECTICUT TOWNS—MPR 88, Off. Corr. Am. 20—8c a gal. price, loaded into containers of 10 gals. or less, deleted for Darien, Greenwich, and Wilton, Conn. Issued 12-1.

SPECIFIC DISTILLATE CEILINGS IN METROPOLITAN CHICAGO AREA AND MAINE; L.P.G. CEILINGS IN CORPUS CHRISTI, TEXAS AREA; MIDWEST SUPPLIERS' CEILINGS TO SERVICE STATION RESELLERS—MPR 88, Am. 21—Reviewed on p. 44, 11-29 NPN.

ALLIED OIL CO. FUEL OIL PRICES TO REPUBLIC STEEL CORP.—MPR 88, Order 54—(*See p. 3, NPN, Nov. 29*).

PUERTO RICO RETAIL KEROSINE CEILINGS—RMPR 137, Am. 7—In Culebra and Vieques Islands gallon price for kerosine is 20c, instead of prevalent 18c. Issued 11-28, effective 12-2.

MISCELLANEOUS AMENDMENTS TO TIRE RATIONING REGULATIONS—RO 1A, Am. 90—No emergency reserve of tires may be obtained for equipment and vehicles, other than commercial motor vehicles, used exclusively for maintaining fire fighting services or public policing services and for off-the-road equipment. An automobile dealer or the RFC may be issued a certificate for a Grade I or III tire for mounting on a new 1942 passenger automobile held for sale, but no certificate for Grade I tire may be issued which would afford applicant more than four Grade I tires to be mounted on such automobile. Procurement Division of Treasury Dept. may transfer new and used tires to a dealer or manufacturer without certificate or authorization. A manufacturer may transfer used tires to a dealer or manufacturer without certificate or authorization. Dealer must keep weight and number record; manufacturer a weight record. Replenishment portions of certificates or receipts transferred to a manufacturer by a dealer or consumer shall be marked "void except for replenishment by . . ." immediately upon acceptance of an order accompanied by replenishment portions. No manufacturer may delay more than seven days in voiding replenishment portions, whether or not accompanied by an order. Issued 11-30, effective 12-4.

TRANSFER OF TIRES—RO 1A, Am. 91—Tires found by manufacturer, before transfer to dealer or consumer, to need reliner, sectional repair, or complete or partial new tread to be made serviceable, designated as Grade III. Also Grade III are new passenger-type tires held for sale by a dealer, if district director has authorized reclassification upon finding by an OPA tire examiner that tire has been so damaged that it cannot reasonably be sold on certificate. District director may, upon dealer's application, issue replenishment portions to replace new passenger-type tires which were reclassified as Grade III tires while in his possession. Any unrationed tires transferred to consumers on or after 12-5-44 (other than those transferred as part of a vehicle or piece of equipment) must be unsuitable for use on the vehicle for which application is made, or other circumstances must justify its transfer. Issued 12-4, effective 12-5.

MISCELLANEOUS GASOLINE RATIONING AMENDMENTS—RO 5C, Am. 164—On supplemental rations for motorcycles the allowed mileage in excess of 400 (instead of 460) miles per month in Area A, 475 (instead of 460) in Area B, must be preferred mileage. Same change made as to official or fleet rations for motorcycles. If holders of transport rations who receive T rations also need bulk transfers of gasoline, or if they are entitled to acquire gasoline on a delayed settlement basis, Board may issue ration checks for such gallonage. Numerous minor changes made to conform ration order to obsolescence of deposit certificates, and to specify Board's endorsements on folders for strip coupons and regulate issuance of ration checks. Issued 12-2, effective 12-6.

CERTIFICATION OF APPLICANTS UNDER AN ORGANIZED TRANSPORTATION PLAN—RO 5C, Am. 165—Upon the refusal of a person in charge of an organized transportation plan to certify an applicant for a supplemental ration, the application must be for-

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warded by such person to the appropriate Board within three days of such refusal, together with a statement of the reasons for the refusal. At the request of the applicant the Board shall review the application and issue the ration if it is satisfied that the applicant is entitled to it. Whenever a District Director determines that an organized transportation plan is not necessary at any plant or facility because it does not offer sufficient benefits to justify its operation, he may issue an order eliminating the certification requirement. Issued 12-2, effective 12-6.

NEW STOVE-DEALER APPLICATIONS—RO 9A, Am. 18—District OPA Office merely sends file on new dealer applications to Washington for approval or disapproval and determination of allowable inventory. WPB approval no longer required. Issued 11-25, effective 11-29.

FUEL OIL RATIONS FOR COMMERCIAL MOTOR VEHICLES—Rev. RO 11, Am. 36—Fuel oil rations for commercial motor vehicles are valid during a calendar quarter if ODT has issued a currently valid Certificate of War Necessity. Applications (no form necessary) for renewals of rations may be made not earlier than 15 days before expiration of current ration. A Board's finding of misuse of ration indicating need for smaller amount, or failure to use all of preceding quarter's ration will result in reduction of amount in renewed ration. Additional rations may be issued to holders of current rations for non-recurring need not extending beyond current calendar quarter. (Application form R-597). Rations will be issued in Class 3 coupon sheets, unless they exceed 5000 gals., when a fuel oil deposit certificate is permitted, upon applicant's request. Fuel oil deposit certificate only will be issued if it was used for previous ration. Issued 12-2, effective 12-6.

SURRENDER OF EVIDENCES—Rev. RO 11, Am. 37—No separate ration bank account may be opened for a dealer establishment which has no registered storage capacity, and any such dealer now having one must close the account by 12-18-44, by issuing checks to the persons to whom he is required to surrender evidences under any of the provisions of this order. Transferors to dealers and primary suppliers within the limitation area must keep records of transactions for at least two years from date of transfer. Deliverers must report failures to surrender evidences of transfer within 15 days after transfer. Issued 12-4, effective 12-8.

DEALER'S TIME FOR FILING STATEMENT EXTENDED TO 12-31-44—Rev. RO 11, Am. 38—Statement on OPA Form R-1198 may be filed by 12-31-44, giving information either as of 10-1 or 12-16-44, at dealer's option. Issued 12-5, effective 12-9.

STATEMENTS REQUIRED FROM REGISTERED DEALERS IN DULUTH-SUPERIOR DISTRICT—Duluth-Superior Order G-1 under Rev. RO 11—All registered dealers coming under Duluth-Superior District Office's jurisdiction, with establishments having a registered storage capacity of between 250 and 999 gals., must file reports on OPA Form R-1198 by 25th of June and December as of 1st day of June and December. If dealer has excess evidences he must surrender them to the district office at the time of filing the statement, together with an explanatory statement. Issued 11-24, effective 11-30.

War Production Board

PURCHASES AND SALES OF CONTROLLED MATERIALS BY AN INTERMEDIARY AND A RESELLER—CMP 1, Direction 48 as am. 11-20-44—Explains how a reseller can purchase steel, copper, or aluminum for his own account for resale, from a person selling under "special sale" provisions of Pri. Reg. 13 (idle, excess, frozen materials). A holder of idle or excess inventory receiving such an order may fill it, but is not required to. Reseller purchasing controlled materials from holder of excess inventory may sell material from holder's property, if holder is willing, or store it temporarily elsewhere. Resellers may sell freely to anyone if not more than $100 worth (cost) of particular controlled material they own is on hand at place of sale. Deliveries when over $100 worth is on hand are subject to special rules of Pri. Reg. 13. Issued 11-20.

SALES OF FROZEN, IDLE, EXCESS MATERIALS—Pri. Reg. 13 as am. 11-22-44—Sales by Government agencies, bankruptcy, liquidation, general auction, and other special sales are subject to Pri. Reg. 13. This regular monthly revision of Pri. Reg. 13 contains changes in the lists of metals, chemicals, machinery and equipment, and miscellaneous materials which may be sold at special sale to certain classes of buyers. Issued 11-22.

PURCHASE OF EQUIPMENT FOR NON-ESSENTIAL CIVILIAN PRODUCTION AND SERVICES—Pri. Reg. 24 as am. 11-21-44—Ultimate user may place an unrated or non-authorized order for an item, covered by a List A order, needed for equipping his factory, store, office, or other establishment for carrying on manufacturing or service operations. Among List A orders are: L-123, general industrial equipment, L-193, conveying machinery and mechanical power transmission equipment, L-221, electric motors and generators, L-250, electric motor controllers. Such unrated orders must specify a particular delivery date or a specified period of not over 31 days. No delivery may be made if supplier knows or believes that user is requesting delivery at an earlier date than actually required. Issued 11-21.

WPB ORDERS COVERED BY PRI. REG. 25—Pri. Reg. 25, Direction 1 as am. 11-21-44—Added to the list of orders governing production of items covered by WPB orders which may be authorized under Pri. Reg. 25 (civilian production) are: L-253, motor truck and trailer bodies ("tank bodies" only), L-145a, anti-friction bearings, and L-237, light power-driven tools. Issued 11-21.

USE OF FORM WPB-4000—Pri. Reg. 25, Direction 2—The application form WPB-4000 under Pri. Reg. 25 may now be used to apply for an allotment of controlled materials or a preference rating (of AA-5), or both, for any product—Class A, Class B, or unclassified, the manufacture of which will, however, still be subject to restrictions of any applicable WPB regulation, unless exempted from such restrictions by listing on Direction 1 (*see above*). Issued 11-21.

Commissioner of Internal Revenue

PROCEDURE UPON CONTRAVENTION OF SALARY STABILIZATION REGULATIONS—Treasury Decision 5416—Discussed in E. E. Hadlick's article on p. 40, 11-29 NPN. Issued 11-3.

Interstate Commerce Commission

LIGHT-WEIGHING OF TANK CARS—2nd Rev. SO 243—Any tank car may be light-weighed on a railroad-owned or industry-owned track scale one time only in connection with each loaded trip. When not accomplished at origin such light-weighing may be performed at destination. Issued 11-24, effective 11-25.

OVERLOADING OF FREIGHT CARS—ICC Service Order 255—Detailed rules of procedure upon discovery of overloaded freight cars set forth by ICC in order issued Nov. 22, to become effective Dec. 7, but suspended by Service Order 255-A, issued Nov. 29, effective Nov. 30.

Office of Defense Transportation

200-MILE MINIMUM REINSTATED FOR MOVEMENT OF TRAFFIC IN RAILWAY TANK CARS—GO ODT 7, Revised, Am. 2—Issued 11-25, effective 12-1.

DELEGATION OF AUTHORITY—AO ODT 29—The Directors of the Highway Transport, Railway Transport, Waterway Transport, and Liquid Transport Departments of the ODT are empowered to perform the functions and exercise the authority delegated to the Assistant Director of ODT, in charge of these four departments, and allied or superseded departments, such as Division of Local Transport, Division of Motor Transport, Division of Traffic Movement, Division of Traffic Personnel, Division of Petroleum and Other Liquid Transport, etc. Issued 11-11, effective 11-15, filed 11-24.

Foreign Economic Administration

PROHIBITED EXPORTATIONS OF CHEMICAL SPECIALTIES—Gen. Regs., Am. 260—No general license now permitted for export of any agricultural insecticides, fungicides, and similar preparations and materials, dry or liquid basis, n.e.s. Issued 11-18, effective 11-27.

PERIOD OF VALIDITY OF INDIVIDUAL EXPORT LICENSES—FEA Individ. License Procedure Regs., Am. 258—Individual licenses effective for calendar quarter for which issued and next succeeding quarter, unless otherwise stated by FEA. Issued 11-18, effective 10-1.

War Food Administration

PYRETHRUM INSECTICIDE AGRICULTURAL USE RESTRICTIONS REVOKED—WFO 46, (former FPO 11) Revocation—Issued 11-27, effective 11-29.

RESTRICTIONS REMOVED ON AGRICULTURAL USES OF ROTENONE INSECTICIDE—WFO 49, (former FPO 13) Revocation—Issued 11-27, effective 11-29.

PAW Trims Staff in Tulsa

NPN News Bureau

TULSA—Personnel of the PAW office here will be reduced to five people according to Patton, Director of Natural Gas and Natural Gasoline for Dist. 2 who will remain as head of the Tulsa office. Since Dec. 1, requisition for priorities has been handled directly from the Chicago office materials division.

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Oil Heat Institute Gets Gloomy Supply Picture From Government Men, Sighting Famine in East

NPN News Bureau

NEW YORK—History is repeating itself, and once again the East Coast is threatened with a petroleum transport crisis that may seriously affect supplies of home heating oil, J. D. Collins, PAW Dist. 1 director-in-charge, told a group of 300 oil and oil burner distributors at the regional meeting of the Oil Heat Institute of America here last week.

Mr. Collins said the crisis, aggravated by the diversion of civilian tank cars and tankers to the military, was equal to the eastern transportation shortage in 1942. That shortage was occasioned, however, by tanker sinkings, while the picture is now different. We are fighting a war on two fronts and meeting the petroleum demands that such an offensive must require.

Deeply pessimistic, Mr. Collins forecast that December would be a very gloomy month. His prediction was supported by the following supply and demand figures:

On Oct. 31, the beginning of the heating season, distillate stocks were 16% higher than they were at the same time last year. However, demand has risen 13% in November over last year and, according to schedule, will be 15% greater in December than a year ago. By the end of December, distillate inventories will be short 17% from December, 1943. Receipts of new supplies, as forecast, are 15% under last year.

"That brings us", Mr. Collins said, "on the last day of this year, to a point where our fuel oil inventory is pressed down to a level 17% under that date a year ago". Receipts of new supply as forecast are 15% under last year in November and it is estimated the percentage for December as compared to a year ago will be about 22% under.

Kerosine inventories were up 50% over last year, he revealed, but on a combined basis (distillate and kerosine) demand is up 13% while supply is down 16%.

Commenting on the recent OPA order (RO 11) permitting consumers who had previously converted from oil to coal to reconvert back to oil, Mr. Collins pointed out that PAW had predicated this move on the assumption that overall rations would not be liberalized. It was unfortunate that this news became public at the very time the war in Europe was going so well, he said. Inventories were beginning to build up and appeals went out to primary suppliers to get material moving into secondary storages and then into consumer tanks. The public, ignorant of the true facts, became over-optimistic and assumed fuel oil stocks were plentiful. The blow was felt when increased military demands and civilian needs came simultaneously.

Further shadows were thrown on the fuel oil picture when John Neukom, OPA director, fuel oil and automotive rationing division, told the group of distributors that the rationing of fuel oil would probably be continued until after V-E Day, and that there was reason to believe it might be necessary to ration this commodity until the end of the Pacific war.

Consumers Too Optimistic

Attributing the fuel oil shortage to the anticipation of military strategists that the European war would be over when the Pacific offensive began, Mr. Neukom warned the association that optimism on the part of consumers was greatly adding to the increased consumption of fuel oil.

It was not disclosed what the unit value of ration coupons would be for periods No. 2 and No. 3. Mr. Neukom said the value of the No. 2 coupon would be designated by Dec. 12, at which time OPA expected to receive PAW's recommendation. Period No. 2 commences Dec. 18.

Elaborating on OPA's forthcoming program, the rationing director set as objectives: 1. Improvement in administration. 2. No letdown in the present program. 3. To seek voluntary compliance of the industry.

A word of warning to conserve rubber consumption on truck tires was passed on to the distributors. Mr. Neukom predicted a shortage by April, 1945.

Other speakers at the morning session of the meeting included Henry Norris, chief of the heating branch of WPB; J. Henry Brody, president, Oil Heat Institute of New England; Frank Spencer, chairman of the distribution division of the institute, and Robert Gray, business manager of Fuel Oil & Heat Magazine.

Mr. Brody told the group that the first question to face in the postwar era was: "Is it possible to make money in the oil burner business without being in the fuel oil business?" He offered these suggestions as a means of making the oil burner business more profitable.

1. Better selection of salesmen.
2. Extensive combined advertising campaigns.
3. Organization of schools to train returning service men in the oil burner business.
4. Cohesive activity for all in the industry.

Discussing the possibilities for the future manufacture of oil burners, Mr. Norris appeared confident that the relaxation of L-74 (which restricts manufacture of burners) would be one of the first orders effective after V-E Day.

Both Mr. Neukom and the Dist. 1 director keyed their addresses to the importance of consumer conservation and the seriousness of the present transportation crisis. Mr. Neukom vigorously urged distributors to warn their customers that the war is not yet over.

"If the transportation crisis were confined only to December the prospects would not be so poor. December is a sad picture. The situation may become worse. PAW has every reason to belive this is not a short-term crisis, that it will extend through the first quarter of 1945", said Mr. Collins. He made it clear to his audience that if there is any step-up in manufacture it will be in the production of Navy Diesel and Pool 21. "These will be manufactured at the expense of home heating oils", he said.

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A. H. Furse Dead

Special to NPN

MIDLAND—A. H. Furse, 45, longtime West Texas independent oil operator, is dead of a heart attack, suffered here while on a business trip. His home was in Eastland, Tex., where funeral services were held.

He was president of the Duquesne Oil Co. and vice-president of the States Oil Co. in Eastland. Survivors are his wife and two sons, Robert and Austin, serving in the Pacific.

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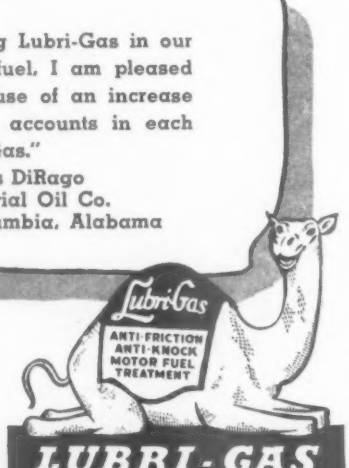

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OIL TREATY DEFUNCT

(*Continued from p. 3*)

out the primary obligations undertaken by the United States? Stated differently, will the power of the Federal Government to regulate or control the oil industry be increased, and the powers now in the States be correspondingly decreased?"

Doubts Switch of Powers

To point (b), Mr. Hardwicke answered:

"I interpret the agreement as meaning that distribution of powers between the nation and the states is not to be changed, and that powers reserved to the states are not taken away from the states and vested in the Federal Government so that the right of the Federal Government to regulate the oil industry is increased; consequently, though a treaty may be written so that power existing in the states is vested in the Federal Government, this agreement, even if ratified as a treaty, will not, in my opinion, have that effect."

As for point (a), Mr. Hardwicke gave the following summary of the "primary obligations" that would be assumed by this country:

"(1) The Government of the United States, in Article I, agrees 'that the development of petroleum resources for international trade should be expanded in an orderly manner on a world-wide basis with due consideration of the factors set forth in paragraph 3 of the Introductory Article and within the framework of applicable laws or concession contracts'.

"(2) The United States, in Article I, agrees to make efforts to bring about the results set forth in the article, such as making available 'adequate supplies of petroleum *** in international trade to the nationals of all peaceable countries at fair prices and on a nondiscriminatory basis' (paragraph 1), and so that 'the development of petroleum resources and the benefits received therefrom by the producing countries shall be such as to encourage the sound economic advancement of those countries' (paragraph 2). There is no obligation, by virtue of language in Article I, to accomplish the aims which are stated in the article.

"(3) The Government of the United States, in Article III, agrees to establish an International Petroleum Commission composed of eight members. This Commission is merely authorized to gather data, make reports and recommendations. It has no enforcement powers. Its recommendations are not self-executing.

(4) The two Governments, in Article IV, assure each other that they will adhere to the principles set forth in paragraph 1 to 6 of Article I, and 'that upon approval of the recommendations of the Commission they will endeavor, in accordance with their respective constitutional procedures, to give effect to such approved recommendations'. There is expressed an assurance that the Government of the United States will adhere to

the principles expressed, but I think there is no obligation to adhere, and there is no obligation to make effective the approved recommendations, though there is an obligation to endeavor to do so, subject to constitutional limitation and existing distribution of powers between the Nation and the States."

Not Self-Executing

PAW's Chief Counsel then proceeded to analyze the agreement Article by Article and wound up with the following conclusions:

"1. The provisions of the agreement are not self-executing.

"2. The International Petroleum Commission is authorized to gather data, study the problems, and make recommendations for carrying out the aims and the general principles which are recognized by the two governments, but

"3. The recommendations of the commission are not binding on the two governments or their nationals.

"4. While the two governments do not obligate themselves to adopt and enforce the recommendations of the commission, each does assure the other that it will undertake to make effective such recommendations as may be approved by it; however,

"5. Applicable laws and concessions contracts are to be recognized, and the distribution of power between the nation and the states is not to be disturbed. Consequently, if a recommendation could not be made effective by the Federal Government because the power to act with respect to such recommendation was within the competence of a state or states, then the agreement does not undertake to change such power. In other words, no power is taken from the states and vested in the Federal Government so that the Federal Government will have power to make effective recommendations which otherwise would require action by a state or states."

Coming Meetings

DECEMBER

Nebraska Petroleum Marketers, Inc., Hotel Fontenelle, Omaha, Nebr., Dec. 5-6-7.

Wisconsin Petroleum Assn., Schroeder Hotel, Milwaukee, Wisc., **Dec. 12-13.**

Interstate Oil Compact Commission, Heidleberg Hotel, Jackson, Miss., Dec. 14-15.

Petroleum Club of Cleveland, Christmas party, Carter Hotel, Cleveland, O., Dec. 18.

JANUARY

Northwest Petroleum Assn., North Dakota and Minnesota section, Radisson Hotel, Minneapolis, Minn., Jan. 4-5.

Associated Motor Carriers of Oklahoma, 14th annual meeting, Mayo Hotel, Tulsa, Okla., Jan. 16-17.

FEBRUARY

Kentucky Petroleum Marketers Assn., Brown Hotel, Louisville, Ky., Feb. 13-14.

Iowa Independent Oil Jobbers' Assn., Hotel Fort Des Moines, Des Moines, Ia., Feb. 21-22.

MARCH

Indiana Independent Petroleum Assn., Inc., Indianapolis, Ind., March 21-22.

APRIL

Independent Petroleum Assn., mid-year meeting of the Board of Directors, New Orleans, La., April 9-10-11.

Benjamin Dennis who, with his brother Overton, has owned and operated the Dominion Oil Co., Richmond, Va., since 1922.

● **"For 10 years,"** says Benjamin Dennis, "my brother and I distributed a well-known brand of products and we had 110 retail outlets in and around Richmond. Then we switched to Richfield—a new brand in our area. What happened? Not only did we hold our old business but we increased our gallonage right from the start."

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Market Reports

ATLANTIC COAST — No price changes during the week. Supplies generally reported feeling the pinch of transportation crisis.

Transport trucks are being used to the greatest extent to ease tank car situation, according to some distributors. Consumer demands for No. 2 fuel oil are increasing and products are beginning to move out of primary storages.

Navy diesels continue on heavy call with increased step-up in production noted.

* * *

CALIFORNIA — California refiners reported the fuel oil situation in this area is tight but not critical, and if a distribution set-up can be worked out there should not be any serious home heating condition. Naphtha and solvent markets still show no change in demand, since all available supplies have rapidly been exhausted. No price changes recorded.

* * *

GULF COAST — Tank car shortage continues to hamper East Coast deliveries. Refiners in Gulf area report difficulty in obtaining both clean and dirty cars.

Supplies of premium gasoline continue scarce while demands are increasing. A refiner in New Orleans last week withdrew his price of 6.75c since he was unable to fill orders. He re-entered the market quoting the ceiling of 4c on diesel oil 43-47 and 4.125c for 53-57 diesel index. Price ranges were unaffected.

* * *

MIDCONTINENT — Flat price of 6.75c on 76 oct. Ethyl in Oklahoma was lowered to range of 6.625-6.75c when refiner reported posting 6.625c for the product Dec. 1. No other price changes reported.

Residual fuel oil reported "tightening"; several refiners say they are on daily production, and customers have asked for additional amount in December. Colder weather bringing on increased demand for heating oils and kerosine.

Kansas and Arkansas refiners report they are still short of gasoline and trying to buy.

Nineteen cars Grade 26-70 natural gasoline reported sold at 4.75c f.o.b. Group 3, and 26 cars reported sold at 4.375c f.o.b. Breckenridge.

* * *

PENNSYLVANIA — Price range of 7.625-8.225c was unaffected the past week when upper field refiner posted 7.75c for "Q" gasoline. Gasoline is reported tight throughout the area.

Several refiners said that No. 2 fuel oil is tight and not moving out of storages to meet seasonal demands. One refiner predicted that although the product is tight the serious shortage will be felt when supplies begin to move out of the Rochester area.

Neutrals continue tight in both the upper and lower fields. Military demands for heavy lubes are absorbing available supplies.

* * *

MIDWEST — Some refiners moving residuals out at prices considerably below ceiling while others report shortages, attempt to buy No. 6 fuel oil to supplement their own production. Several in Midwestern area have exhausted storages and are now or will soon be working on daily production, insufficient to fill demand in some cases.

Michigan refiners continue with short storages of residual with several reporting unsuccessful attempts to purchase in large quantities.

Drop in temperature brought increasing call for heating oils.

N.P.N. Gasoline Index

	Dealer T.W.	Tank Car
	Cents Per Gal.	
Dec. 4	10.38	6.72
Month ago	10.40	6.73
Year ago	10.45	6.92

Dealer index is an average of "undivided" dealer prices, ex-tax, in 50 cities.

Tank car index is weighted average of following wholesale markets for regular-grade gasoline, FOB refineries or terminals: Okla., Mid-Western, W. Penna., Calif., N. Y. Harbor, Philadelphia, Jacksonville, Boston and Gulf Coast.

CRUDE PRICES

Since changes in crude oil prices are so few, the two pages of crude oil price tables hereafter will be printed only when there are sufficient changes in prices to warrant.

In the meantime a record is being kept in the Cleveland office of NPN and OILGRAM from which the publishers will be glad to make proofs, or letters or affidavits as to what the prices are, and without charge to regular subscribers. Changes in crude oil prices will be specially noted in this market section when made.

Crude Price Changes

Ohio Oil Co. announced 13c increase in price of Lance Creek (Wyo.) crude, effective Nov. 24, 1944, from $1.12 to $1.25.

The Texas Co. announced 5c increases in prices of Delta Farms, Golden Meadow, Lake Salvador and Bay de Chene crudes, all in Louisiana, effective Nov. 9, 1944. These crudes from date noted were included in company's Gulf Coast Louisiana Schedule 3, beginning with Below 20 at $0.90 and ending with 40 & Above at $1.25.

For latest table of crude prices published, see NPN, Nov. 29, pages 52, 53 and 46.

Summary of Daily Gasoline Prices (November 27 to December 4)

	Monday Dec. 4	Friday Dec. 1	Thursday Nov. 30	Wednesday Nov. 29	Tuesday Nov. 28
U. S. Motor (ASTM octane)					
76 octane Ethyl:					
Oklahoma	6.625- 6.75	6.625- 6.75	6.75	6.75	6.75
Mid-Western (Group 3 basis)	6.75	6.75	6.75	6.75	6.75
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7	7	7	7	7
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	7 (2)	7 (2)	7 (2)	7 (2)	7 (2)
70-74 octane:					
Oklahoma	5.875	5.875	5.875	5.875	5.875
Mid-Western (Group 3 basis)	5.875	5.875	5.875	5.875	5.875
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.875	5.875	5.875	5.875	5.875
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.875	5.875	5.875	5.875	5.875
63-66 octane:					
Oklahoma	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
Mid-Western (Group 3 basis)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)	5.625 (2)
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)	5.625 (1)
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)	5.75 (1)
60 octane & below:					
Oklahoma	5.25	5.25	5.25	5.25	5.25
Mid-Western (Group 3 basis)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
N. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25	5.2 - 5.25
W. Tex. (For shpt. to Tex. & N. M. dest'ns.)	5.25	5.25	5.25	5.25	5.25
Motor Gasoline, 70-74 oct.					
New York harbor	9.075	9.075	9.075	9.075	9.075
New York harbor, barges	8.975	8.975	8.975	8.975	8.975
Philadelphia district	9.075	9.075	9.075	9.075	9.075
Baltimore district	8.825	8.825	8.825	8.825	8.825
Motor Gasoline:					
Western Penna. Bradford-Warren:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.625- 8.225	7.625- 8.225	7.625- 8.225	7.625- 8.225	7.625-8.225
Western Penna. Other Districts:					
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.725	7.725	7.725	7.725	7.725

Note: To conform with Article IV of MPR 88 as amended August 15 we are substituting 70-74 oct. ASTM for the old 72-74 oct. ASTM. We continue to include in this group, Housebrand quotations.

REFINERY OPERATIONS

(American Petroleum Institute figures in thousands of barrels of 42 gal. each. Figures include reported totals plus estimate of unreported amounts and are therefore on a Bureau of Mines basis.)

	Daily Potential Refining Capacity Week Ended		Daily Average Crude Runs to Stills Week Ended		Gasoline Production at Refineries inc. Natural Blended Week Ended		Kerosine Production Week Ended		Gas Oil & Dist. Fuel Oil Production Week Ended		Residual Fuel Oil Production Week Ended	
	Nov. 25	Nov. 18	Nov. 25	Nov. 18	Nov. 25	Nov. 18	Nov. 25	Nov. 18	Nov. 25	Nov. 18	Nov. 25	Nov. 18
East Coast	729	729	700	631	1,610	1,668	165	105	865	730	1,681	1,388
Appalachian (Dist. No. 1)	130	130	106	100	309	269	69	65	71	86	77	79
Appalachian (Dist. No. 2)	47	47	54	42	170	145	9	3	39	43	90	80
Ind., Ill., Ky.	824	824	785	761	2,932	2,802	268	275	681	535	1,102	1,023
Okla., Kans., Mo.	418	418	378	358	1,479	1,333	119	127	399	384	476	431
Inland Texas	278	278	245	232	962	932	96	91	121	111	454	464
Texas Gulf Coast	1,165	1,165	1,146	1,145	3,560	3,825	384	461	1,205	1,385	1,925	2,006
Louisiana Gulf Coast	242	242	266	263	735	818	234	242	424	310	344	371
No. La., & Arkansas	104	104	83	79	235	217	50	52	68	74	126	118
Rocky Mt. (Dist. No. 3)	13	13	11	12	307	38	17	4	59	7	151	31
Rocky Mt. (Dist. No. 4)	141	141	100	98	91	377	3	12	21	71	79	178
California	817	817	798	846	2,159	2,155	38	42	531	700	2,487	2,655
Total U. S.—B. of M. Basis	4,908	4,908	4,672	4,567	14,549	14,579	1,452	1,479	4,484	4,436	8,992	8,824
U.S.—B. of M. Basis Nov. 27, 1943			4,282		12,614		1,474		4,379		8,726	

Districts	Stocks of Finished and Unfinished Gasoline Week Ended		Total Stocks Kerosine Week Ended		Total Stocks Gas Oil & Distillates Week Ended		Total Stocks Residual Fuel Oil Week Ended	
	Nov. 25	Nov. 18	Nov. 25	Nov. 18	Nov. 25	Nov. 18	Nov. 25	Nov. 18
East Coast	11,995	12,205	6,101	6,240	14,040	14,623	10,351	10,401
Appalachian (Dist. No. 1)	2,445	2,348	311	352	492	516	326	337
Appalachian (Dist. No. 2)	1,570	1,511	78	49	218	205	145	125
Ind., Ill., Ky.	16,028	15,942	2,533	2,567	7,181	7,071	3,763	3,854
Okla., Kans., Mo.	7,460	6,966	782	789	2,455	2,546	1,645	1,632
Inland Texas	2,843	2,705	275	264	428	438	601	605
Texas Gulf Coast	14,451	14,414	1,737	2,031	7,655	7,619	8,216	8,427
Louisiana Gulf Coast	4,132	4,171	855	893	2,180	2,284	1,202	1,219
No. La. & Arkansas	2,406	2,235	236	382	637	652	316	312
Rocky Mt. (Dist. No. 3)	65	67	...	...	19	19	31	32
Rocky Mt. (Dist. No. 4)	1,655	1,603	108	105	387	386	589	604
California	14,371	14,574	486	465	11,409	11,658	35,650	35,753
Total U. S.—B. of M. Basis	79,421*	78,741	13,502	14,137	47,101	48,017	62,835	63,301
U. S.—B. of M. Basis Nov. 27, 1943	69,229		10,699		45,449		61,735	

*Composed of 13,017,000 bbls. of unfinished, 41,484,000 bbls. civilian-grade automotive and 24,920,000 bbls. aviation, military, solvents and naphthas, and gasoline blending stocks currently indeterminate as to ultimate use.

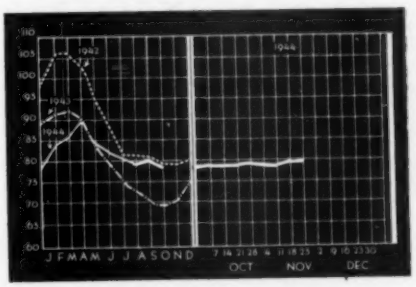
Daily Av. Pennsylvania Crude Runs

(Compiled by National Petroleum Assn. from reports of all companies refining Pennsylvania crude. Figures in bbls.)

Week Ended Nov. 25, 1944	Week Ended Nov. 18, 1944	Week Ended Nov. 27, 1943
64,446	67,418	71,950

Gasoline Stocks

(Millions of Barrels)



U. S. Crude Oil Production

(American Petroleum Institute figures)

	WEEK ENDED Barrels (Daily Average) Nov. 25	Barrels (Daily Average) Nov. 18
Oklahoma	357,250	358,500
Kansas	274,200	282,700
Nebraska	950	1,000
Texas	2,132,300	2,132,300
Louisiana	363,650	363,550
Arkansas	80,300	80,450
Mississippi	52,950	52,550
Alabama	250	250
Florida	50	50
Illinois	211,400	190,450
Indiana	13,350	12,500
Eastern (Ill., Ind. & Ky. excluded)	63,850	66,750
Kentucky	29,400	30,400
Michigan	47,800	49,800
Wyoming	96,950	93,700
Montana	21,350	21,350
Colorado	9,350	9,650
New Mexico	104,850	104,850
California	875,800	888,500
Total, U. S.	4,736,000	4,738,850

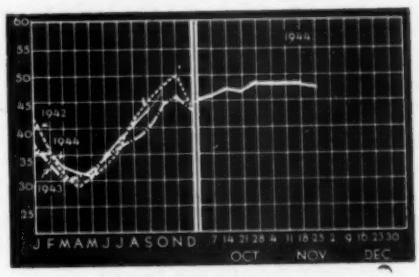
Crude Oil Stocks

(Bureau of Mines Figures in thousands of bbls.)

Grade or Origin	Nov. 18	Nov. 25	Change from Nov. 18
Penna. Grade	2,334	2,302	— 32
Other Appalachian	1,557	1,533	— 24
Lima-Michigan	904	914	+ 10
Illinois-Indiana	14,450	14,525	+ 75
Arkansas	2,747	2,717	— 30
Kansas	8,468	8,345	—123
Louisiana:	13,194	13,032	—162
Northern	3,549	3,299	—250
Gulf Coast	9,645	9,733	+ 88
Mississippi	873	956	+ 83
New Mexico	6,455	6,565	+110
Oklahoma	29,174	29,469	+295
Texas:	111,091	111,222	+131
East Texas	19,572	19,743	+171
West Texas	32,387	32,271	—116
Gulf Texas	30,535	30,391	—144
Other Texas	28,597	28,817	+220
Panhandle	6,226	6,197	— 29
North	7,157	7,009	—148
South	6,493	6,786	+293
Other	8,721	8,825	+104
Rocky Mountain	7,119	7,089	— 30
California	20,481	20,958	+477
Foreign	2,584	2,333	—251
Total gasoline bearing in U. S.	221,431	221,960	+529
Heavy in California	6,657	6,663	+ 6

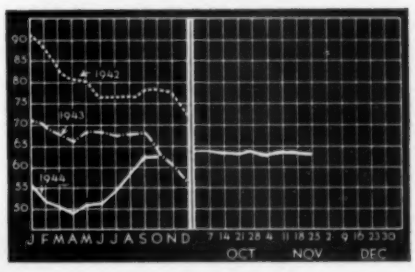
Gas Oil & Distillate Stocks

(Millions of Barrels)



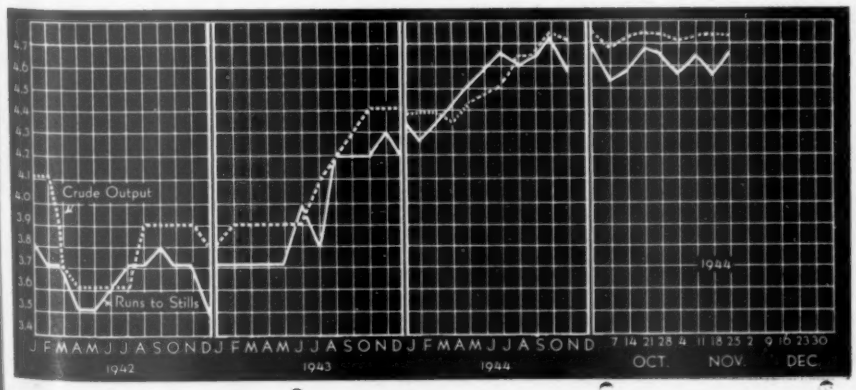
Residual Fuel Oil Stocks

(Millions of Barrels)



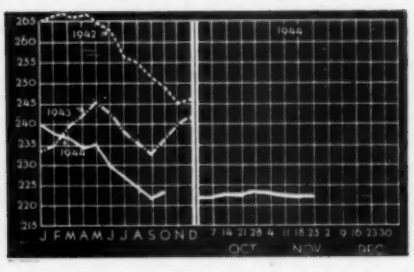
Crude Production & Runs to Stills

(Millions of Barrels)


Crude Output
Runs to Stills
1944
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
7 14 21 28 4 11 18 25 2 9 16 23 30
1942
1943
1944
OCT.
NOV.
DEC.

Crude Oil Stocks

(Millions of Barrels)



OIL PRICE SECTION ★ At Refineries and Terminals and by Tank Wagon

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Refinery Prices

Gasoline —U. S. Motor (A S T M) except where otherwise specified.

	Prices in Effect Dec. 4	Nov. 27
OKLAHOMA		
76 oct. Ethyl...	6.625–6.75	6.75
70-74 oct.....	5.875	5.875
63-66 oct.....	5.625 (1)	5.625 (1)
60 oct. & below.	5.25	5.25
MID-WESTERN (Group 3 basis)		
76 oct. Ethyl...	6.75	6.75
70-74 oct.....	5.875	5.875
63-66 oct.....	5.625 (2)	5.625 (2)
60 oct. & below.	5.2 – 5.25	5.2 – 5.25
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl...	7	7
70-74 oct.....	5.875	5.875
63-66 oct.....	5.625 (1)	5.625 (1)
60 oct. & below.	5.2 – 5.25	5.2 – 5.25
W. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
76 oct. Ethyl...	7 (2)	7 (2)
70-74 oct.....	5.875	5.875
63-66 oct.....	5.75 (1)	5.75 (1)
60 oct. & below.	5.25	5.25
CENT. W. TEX. (Prices to truck transports)		
76 oct.....	7 (2)	7 (2)
70-74 oct.....	5.875 (2)	5.875 (2)
67-69 oct.....	....	....
62 oct. & below.	5.25 (2)	5.25 (2)
KANSAS (For Kansas destinations only)		
76 oct. Ethyl...	7.2 – 7.3	7.2 – 7.3
70-74 oct.....	6.2	6.2
63-66 oct.....	5.9 (2)	5.9 (2)
60 oct. & below.	5.5	5.5
ARK. (For shipment to Ark. & La.)		
76 oct. Ethyl...	7 (1)	7 (1)
70-74 oct.....	5.875 (1)	5.875 (1)
62 oct. "	....	....
60 oct. & below, unleaded.....	5.25 (1)	5.25 (1)
WESTERN PENNA. (Motor gasoline)		
Bradford-Warren:		
"Q" Gasoline Min. 70 Oct. (ASTM)	7.625-8.225(a)	7.625-8.225(a)
Other districts		
"Q" Gasoline, Min. 70 Oct. (ASTM)	7.725	7.725

(a) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

Prices in Effect	Dec. 4	Nov. 27
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
U.S. Motor: (Oct. ASTM):		
70-74 oct.....	7.875– 8.375	7.875– 8.375
67-69 oct.....	....	....
Str. run gasoline, excluding Detroit shpt.....	6	6
OHIO (S. O. Ohio quotations for statewide delivery and subject to exceptions for local price disturbances).		
70-74 oct.....	8.25	8.25
CALIFORNIA U.S. Motor:		
76 oct. (Ethyl)....	7.5 – 8.75	7.5 – 8.75
70-74 oct.....	6.5 – 7.75	6.5 – 7.75
65 oct. & below (3rd grade).....	5.75 – 6.25	5.75 – 6.25

Kerosine, & Gas Fuel Oils

OKLAHOMA		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5	4.5
Range oil.....	4	4
No. 1 p.w.....	3.875	3.875
No. 1 straw.....	....	....
No. 2 straw.....	3.625	3.625
No. 3 fuel.....	3.5 (2)	3.5 (2)
No. 6 fuel.....	$0.90–$0.97	$0.90–$0.97
U. G. I. Gas Oil..	....	....
14-16 fuel.....	$0.97 (2)	$0.97 (2)
MID-WESTERN (Group 3 basis)		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5	4.5
Range Oil.....	4 –4.1 (2)	4 –4.1 (2)
No. 1 p.w.....	3.875	3.875
No. 2 straw.....	3.625	3.625
No. 3.....	....	....
No. 5.....	....	....
No. 6.....	$0.97 (1)	$0.97 (1)
N. TEX. (For shpt. to Tex. & N. M. dest'ns.)		
41-43 grav. w.w...	4.375	4.375
42-44 grav. w.w...	4.5 (1)	4.5 (1)
No. 1 p.w.....	3.875 (1)	3.875 (1)
No. 6 fuel.....	$0.90–$0.97 (2)	$0.97 (2)
AMARILLO, TEX. (For shpt. to W. Okla. & Tex. differential territory.)		
42-44 grav. w.w...	4.5 (1)	4.5 (1)
KANSAS (For Kansas destinations only).		
41-43 grav. w.w...	No Price	No Price
42-44 grav. w.w...	4.7	4.7
No. 1 p.w.....	4.1	4.1
No 6 fuel.....	$0.95–$1.02	$0.95–$1.02
ARK. (For shipment to Ark. and La.)		
41-43 grav. w.w...	....	....
42-44 w.w. kero...	4.5 (1)	4.5 (1)
No. 1.....	....	....
No. 2.....	3.625 (1)	3.625 (1)
No. 3 fuel.....	3.5 (1)	3.5 (1)
Tractor fuel, for shpt. to Ark. points only.....	5.125 (1)	5.125 (1)
Diesel fuel 52 & below.....	4 (1)	4 (1)
Diesel fuel 58 & above.....	4.25 (1)	4.25 (1)
WESTERN PENNA.		
Bradford-Warren:		
45 grav. w.w.....	6.5 – 7.55	6.5 – 7.55
46 grav. w.w.....	.....	.....
No. 1 fuel.....	6.55-7.55(2&b)	6.55-7.55(2&b)
No. 2 " ...	6.125-7.125(2&b)	6.125-7.125(2&b)
No. 3 "	6.25–7.25(1&b)	6.25–7.25(1&b)
36-40 gravity.....	6.625-6.75(2)	6.625-6.75(2)

(b) Highs and lows for Schedule D area, in MPR 88 and outside Schedule D area, respectively.

Other districts:		
45 grav. w.w.....	7 – 7.425	7 – 7.425
46 grav. w.w.....	7.25 – 7.375	7.25 – 7.375
47 grav. w.w.....	7.375– 7.50	7.375– 7.50
No. 1 fuel.....	6.875– 7.125	6.875– 7.125
No. 2 "	6.75 – 6.875	6.75 – 6.875
No. 3 "	6.75	6.75
36-40 grav. Pittsburgh dist. prices excluded.....	6.625-6.875	6.625– 6.875
CENTRAL MICHIGAN (FOB Central Mich. refinery group basis for shpt. within Mich.; shpts. may originate at plants outside Central group.)		
47-49 gravity w.w.	5.8 – 6	5.8 – 6
P.W. Distillate...	5.5	5.5
No. 3 gas oil, Straw	5	5
U.G.I. gas oil.....	4.5 (2)	4.5 (2)
Fuel Oils (*Vis. at* 100).		
300-500 Vis.....	4.14 (1)	4.14 (1)
100-300 Vis.....	4.5	4.5
OHIO (S. O. quotations for statewide delivery) Kerosine.....	7	7

Prices in Effect	Dec. 4	Nov. 27
CALIFORNIA		
40-43 grav. w.w...	5 – 7	5 – 7
San Joaquin Valley:		
Heavy fuel.....	$1.10 (2)	$1.10 (2)
Light fuel.....	$1.20 (2)	$1.20 (2)
Diesel fuel.....	4 (2)	4 (2)
Stove dist.....	5 (2)	5 (2)
Los Angeles:		
Heavy fuel.....	$1.10 (2)	$1.10 (2)
Light fuel.....	$1.20 (2)	$1.20 (2)
Diesel fuel.....	4 (2)	4 (2)
Stove dist.....	5 (1)	5 (1)
San Francisco:		
Heavy fuel.....	$1.15 (1)	$1.15 (1)
Light fuel.....	$1.25 (1)	$1.25 (1)
Diesel fuel.....	4.5 (1)	4.5 (1)
Stove dist.....	5.5 (1)	5.5 (1)

NOTE: All above heavy fuels meet Pacific specification 400; light fuel, spec. 300; Diesel fuels, spec. 200; and stove distillate, spec. 100.

Lubricating Oils

Prices in Effect	Dec. 4	Nov. 27
WESTERN PENNA.		
Prices are for sales made, or offers reliably reported, to jobbers & compounders only.		
Viscous Neutrals—*No. 3 col. Vis. at 70°F.*		
200 Vis. (180 at 100°) 420-425 fl.		
0 p.t.....	38 (1)	38 (1)
10 p.t.....	37 (1)	37 (1)
15 p.t.....	36 (1)	36 (1)
25 p.t.....	28–33	28–33
150 Vis. (143 at 100°) 400-405 fl.		
0 p.t.....	36 (1)	36 (1)
10 p.t.....	35 (1)	35 (1)
15 p.t.....	34 (1)	34 (1)
25 p.t.....	26–31	26–31

NOTE: Limited quantity neutrals available to regular trade.

Cylinder Stocks:

Brt. stk., 145-155 *vis. at* 210°, 540-550 fl., *No. 8 col.*		
10 p.t.....	30.5 (1)	30.5 (1)
15 p.t.....	29.5 (1)	29.5 (1)
25 p.t.....	25	25
600 S.R. filterable	15	15
650 S.R.....	15.5	15.5
600 fl.....	16	16
630 fl.....	17	17

MID-CONTINENT (F. o. b. Tulsa)

Neutral Oils (*Vis. at* 100° *F. 0 to 10 P.P.*)

Pale Oils:

Vis. Color		
60-85—No. 2....	7.5	7.5
86-110—No. 2...	7.5 – 8.5	7.5– 8.5
150—No. 3.....	11 –11.5	11 –11.5
180—No. 3.....	11.5 –15	11.5–15
200—No. 3.....	12 –15	12 –15
250—No. 3.....	14 –16.5	14 –16.5
280—No. 3.....	15 –17	15 –17
300—No. 3.....	16 –18	16 –18
Red Oils:		
180—No. 5.....	11.5 (1)	11.5 (1)
200—No. 5.....	12 (1)	12 (1)
280—No. 5.....	No Price	No Price
300—No. 5.....	16–17.5(2)	16–17.5(2)
Bright Stock—*Vis. at* 210°		
200 Vis. D.....	27 (1)	27 (1)
150-160 Vis. D:		
0 to 10 p.p....	23	23
10 to 25 p.p....	22.5–23	22.5–23
25 to 40 p.p....	23 (1)	23 (1)
150-160 Vis. E....	22 (1)	22 (1)
120 Vis. D:		
0 to 10 p.p.....	22 (2)	22 (2)
600 S.R. Dark Green.....	8.5 (1)	8.5 (1)
600 S.R. Olive Green.....	10-11 (2)	10-11 (2)
631 S.R.....	....	....
Black Oil.....	....	....

NOTE: Discounts of 0.5c to 1c on bright stock and 0.5c to 2c allowed for neutrals, 10 car lots, and to "meet competition." Brokers offering at greater discounts.

SOUTH TEXAS (Neutral Oils)

Pale Oils (*Vis. at* 100°*F.*)

Vis. Color		
100 No. 1½-2½.	6.5	6.5
200 No. 2-3.....	8.75	8.75
300 No. 2-3.....	9.25	9.25
500 No. 2½-3½.	10	10
750 No. 3-4.....	10.25	10.25
1200 No. 3-4.....	10.375	10.375
2000 No. 4.....	10.5	10.5

(Continued on next page)

NOTE—Parenthetical figures after prices indicate number of companies quoting when less than three companies are quoting.

NOTICE—Owing to great demand, refiners generally limit quotations to regular customers and refuse bids, though higher, from others. Refiners' prices and sales shown; bids reported in market leads.

Refinery Prices (Continued)

Prices in Effect	Dec. 4	Nov. 27
Red Oils:		
100 No. 5-6	6.5 (2)	6.5 (2)
200 No. 5-6	8.75	8.75
300 No. 5-6	9.25	9.25
500 No. 5-6	10	10
750 No. 5-6	10.25	10.25
1200 No. 5-6	10.375	10.375
2000 No. 5-6	10.5	10.5

CHICAGO (From Mid-Continent p.l. crude.) Neutral oils *vis. at* 100° *F. 0 to* 10 *p.p.*

Pale Oils Vis. Color		
60-85—No. 2	9 (1)	9 (1)
86-110—No. 2	9.25 (1)	9.25 (1)
150—No. 3	12.5 (1)	12.5 (1)
180—No. 3	13 (1)	13 (1)
200—No. 3	13 (1)	13 (1)
250—No. 3	14 (1)	14 (1)
Red Oils:		
180—No. 5	13 (1)	13 (1)
200—No. 5	13 (1)	13 (1)
250—No. 5	14 (1)	14 (1)
280—No. 5	15 (1)	15 (1)
300—No. 5	15.5 (1)	15.5 (1)

Note: Viscous oils, 15 to 30 p.p. are quoted 0.5c lower; 60-85 and 86-110 No. 2 non-viscous oils, 15 to 30 p.p., 0.25c lower.

Unfiltered Steam Refined (*Viscosity at* 210°)		
140	11.5 (1)	11.5 (1)
160	12.5 (1)	12.5 (1)
200	13.5 (1)	13.5 (1)

Bright stocks, 160 *vis. at* 210 *No.* 8 *color:*		
0 to 10 p.p.	24 (1)	24 (1)
15 to 25 p.p.	23.5 (1)	23.5 (1)
30 to 40 p.p.	21.5 (1)	21.5 (1)
E filtered Cyl. Stock	15.5 (1)	15.5 (1)

Note: To obtain prices delivered in Chicago add 0.25c per gal.

Natural Gasoline

Group 3 & Breckenridge prices are to blenders on freight basis shown below. Shipments may originate in any Mid-Continent manufacturing district.

FOB GROUP 3

Grade 26-70 4.75 (Quote) 4.75 (Sales)

FOB BRECKENRIDGE

Grade 26-70 4.375 (Quotes) 4.375 (Sales)

CALIFORNIA (FOB plants in Los Angeles basin)

21 pound vapor pressure for blending	4.75 – 5.375	4.75 – 5.375

Naphtha and Solvent

(*FOB Group* 3)		
Stoddard solvent	6.625	6.625
Cleaners' naphtha	7.125	7.125
V.M.&P. naphtha	7.1 – 7.125	7.1 – 7.125
Mineral spirits	6.1 – 6.125	6.1 – 6.125
Rubber solvent	7.1 – 7.125	7.1 – 7.125
Lacquer diluent	7.375– 8.125	7.375– 8.125
Benzol Diluent	7.875– 8.625	7.375– 8.625

WESTERN PENNA.

Other Districts:		
Untreated naphtha	7 –7.25 (2)	7 –7.25 (2)
Stoddard solvent	7.25 –7.5 (2)	7.25 –7.5 (2)

OHIO (S. O. quotations for statewide delivery):

V.M.&P. naphtha.	D.C. naphtha,	Varnolene &
Sohio solvent	10	10
Rubber solvent	9	9

Wax

WESTERN PENNA. (Bbls. C.L.)

White Crude Scale:		
122-124 A.m.p.	4.25 (2)	4.25 (2)
124-126 A.m.p.	4.25	4.25

OKLAHOMA (C.L. FOB Refinery)

Semi-refined:		
128 AMP min., white, 50 kilo bags	No Price	No Price
132-134 AMP, bbls.	5(1)	5(1)

CHICAGO (FOB Chicago district refinery of one refiner, in bags, carloads. Carloads, slabs loose, 0.4c less. Melting points are EMP (ASTM) methods; add 3° to convert into AMP.)

Fully refined:		
122-124 (bags only)	5.6	5.6
125-127	6	6
127-129	6.25	6.25
130-132	6.55	6.55
132-134	6.8	6.8
135-137	7.55	7.55

Petrolatums

WESTERN PENNA. (Bbls., carloads; tank cars, 0.5c per lb. less.)

Snow White	6.125– 7.25	6.125– 7.25
Lily White	5.375– 6.25	5.375– 6.25
Cream White	4.375– 5.5	4.375– 5.5
Light Amber	3.375– 4	3.375– 4
Amber	3.125– 3.75	3.125– 3.75
Red	3 – 3.5	3 – 3.5

Tank Wagon Prices

Commercial or consumer tank car, tank wagon, dealer, and service station prices for gasoline **do not include** *taxes; they do, however, include inspection fees as shown in general footnote. Gasoline taxes, shown in separate column, include 1.5c federal, and state taxes; also city and county taxes as indicated in footnotes. Kerosine tank wagon prices also do not include taxes; kerosine taxes where levied are indicated in footnotes. Dealer discounts are shown in footnotes. These prices in effect Dec. 4, 1944 as posted by principal marketing companies at their headquarters offices, but subject to later correction*

S. O. N. J.

Esso (*Regular Grade*)

	Consumer Tank Wagon	Dealer T.W.	Gasoline Taxes	Kerosine T.W.
*Atlantic City, N. J.	10.2	10.7	4.5	10
*Newark, N. J.	10.2	10.7	4.5	10
Annapolis, Md.	10.55	11.05	5.5	....
Baltimore, Md.	9.95	10.45	5.5	10.8
Cumberland, Md.	11.35	11.85	5.5	12.3
Washington, D. C.	10.2	10.7	4.5	11.3
Danville, Va.	11.65	12.15	6.5	12.55
Norfolk, Va.	10.45	10.95	6.5	12.3
Petersburg, Va.	10.75	11.25	6.5	13.3
Richmond, Va.	10.75	11.25	6.5	13.3
Roanoke, Va.	11.95	12.45*	6.5	12.8
Charleston, W. Va.	11.65	12.15*	6.5	13.1
Parkersburg, W. Va.	10.95	11.45	6.5	12.8
Wheeling, W. Va.	10.95	11.45*	6.5	13.4
Charlotte, N. C.	11.70	12.20*	7.5	11.3
Hickory, N. C.	12.25	12.75	7.5	12.3
Mt. Airy, N. C.	12.10	12.6	7.5	11.5
Raleigh, N. C.	11.45	11.95	7.5	12.3
Salisbury, N. C.	11.75	12.25	7.5	12.7
Charleston, S. C.	10.55	11.05	7.5	.....
Columbia, S. C.	11.40	11.9	7.5	.....
Spartanburg, S. C.	12.1	12.6	7.5	.....

*Correct on and since Sept. 1.

	Mineral Spirits T.W.	V.M.&P. T.W.
Newark, N. J.	13	14.5
Baltimore, Md.	15.5	....
Washington, D. C.	15.5	....

Fuel Oils—T.W.	No. 1	No. 2	No. 3
Atlantic City, N. J.	10	9	9
Newark	10	9	9
Annapolis, Md.	..	..	..
Baltimore	9.8	9	9
Washington, D. C.	10.3	9.4	9.4
Norfolk, Va.	10	8.8	8.8
Petersburg	10.3	9	..
Richmond	10.3	9	9
Charlotte, N. C.	10.3	10.1	..
Hickory, N. C.	..	9.7	..
Raleigh	11.3	9.8	..
Charleston, S. C.	..	8.7	..
Columbia	..	9.7	..
Spartanburg	..	10.5	..

*Effective Aug. 5, '42 minimum retail resale price of 14.2c posted thru New Jersey.

Discounts:

Esso gasoline—to undivided dealers, 0.5c off dealer t.w.

Kerosine—1c off t.w. price for 25 gals. or more, under contract thru territory (Baltimore city contract not necessary) except no discount in state of New Jersey.

Naphtha—To buyers taking following quantities at one time: Newark, 2c per gal. on 200 gals. or more, less than 200 gals. 0.5c higher price; Baltimore, 2c off on 25 to 100 gals. and 3c on over 100 gals.; Washington, 2c off to contract buyers.

Notice

These prices include inspection fees on both gasoline and kerosine unless otherwise specified per gallon as follows:

Ala. 1/40c on gasoline; Ark. 1/20c; Fl. 1/8c; Ill. 3/100c; Ind. 1/5c in lots of 25 bbls. or less, 2/25c in lots of more than 25 bbls.; Kans. 1/50c; La. 1/32c; Minn. 7/200c; Miss. 1/50c; Neb. 3/100c; Nev. 1/20c; N. C. 1/4c; N. Da. 1/20c; Okla. 2/25c; S. Car. 1/8c; S. Da. 1/20c; Tenn. 2/5c; and Wisc. 3/100c.

Kerosine inspection fees only: Ala. 1/2c; Fla. 1/8c; Iowa 3/50c; Mich. 1/5c per gal.

CONT'L OIL

	Conoco Bronz-z-s mand (*3rd Grade*) †Tank Wagon	Gasoline Taxes	Kerosine T.W.
Denver, Col.	10	9	5.5	10
Grand Junc., Col.	12.5	11.5	5.5	12.5
Pueblo, Col.	9.5	8.5	5.5	9.5
Casper, Wyo.	11.5	10.5	5.5	12
Cheyenne, Wyo.	10	9	5.5	9
Billings, Mont.	12	11	6.5	12.5
Butte, Mont.	11.5	10.5	6.5	13.5
Great Falls, Mont.	12	11	6.5	12.5
Helena, Mont.	12	11	6.5	13
Salt Lake City, Utah	13.5	12.5	5.5	14.5
Boise, Ida.	13.6	12.6	6.5	16.5
Twin Falls, Ida.	14.6	13.6	6.5	17
Albuquerque, N. M.	10.5	9.5	*7	9.5
Roswell, N. M.	10	9	*7	7
Santa Fe, N. M.	10.5	9.5	*7.5	10
Ft. Smith, Ark.	9	6.25	*7	8
Texarkana, Ark.	9	7.5	*5.5	7
Muskogee, Okla.	7.75	6.75	7	8
Oklahoma City, Okla.	8	7	7	8
Tulsa, Okla.	8	7	7	8

*Taxes: In gasoline tax column are included these city taxes—Albuquerque, & Roswell, 0.5c, Santa Fe, 1c. Texas 4c state tax applies within city limits of Texarkana, Ark.; Okla., 5.5c state applies within city limits of Ft. Smith, Ark.

†To Consumers & Dealers.

NOTE: Current selling price—where this is lower than maximum price it is because of local competition. It is the actual selling price and is subject to revision due to delays in receiving information from the field.

S. O. NEB.

(*Regular Grade*)	T.W. Dealer	Gasoline Taxes	Kerosine T.W.
Omaha	11.4	9.6	6.5	10.1
McCook	12.0	10.1	6.5	10.5
Norfolk	11.9	10.4	6.5	10.6
North Platte	12.2	10.6	6.5	11
Scottsbluff	12.9	10.2	6.5	10.5

S. O. CAL.

Standard Gasoline (*Regular Grade*) **Flight Gasoline** (*Third Grade*)

	Standard Posted Net Tank Truck	Standard Posted Retail	Flight Posted Net Tank Truck	Flight Posted Retail	Gasoline Taxes
San Francisco, Cal.	10	14	9	12	4.5
Los Angeles, Cal.	9.5	13.5	8.5	11.5	4.5
Fresno, Cal.	11	15	10	13	4.5
Phoenix, Ariz.	12	16	10	13	6.5
Reno, Nev.	12	16	11	14	5.5
Portland, Ore.	10.5	14.5	9.5	12.5	6.5
Seattle, Wash.	10.5	14.5	9.5	12.5	6.5
Spokane, Wash.	12.5	16.5	11.5	14.5	6.5
Tacoma, Wash.	10.5	14.5	9.5	12.5	6.5

Std. Aviation 73

	Posted Net Tank Truck	Gasoline Taxes	Kerosine Tank Truck
San Francisco, Cal.	12.5	4.5	11.5
Los Angeles, Cal.	12	4.5	10
Fresno, Cal.	13.5	4.5	12.5
Phoenix, Ariz.	14.5	6.5	12.5
Reno, Nev.	14.5	5.5	13.5
Portland, Ore.	13	6.5	13.8
Seattle, Wash.	13	6.5	13.8
Spokane, Wash.	16	6.5	16.8
Tacoma, Wash.	13	6.5	13.8

Resale and Commercial Gasoline: Tank car deliveries of Standard Aviation 73, Standard's Supreme and Flight Gasoline .25c per gal. below posted net tank truck price. Tank car deliveries of Standard Gasoline .375c per gal. below posted net tank truck price. Pearl Oil (The Standard Kerosene) Tank car deliveries 3c below posted tank truck price.

TEXAS CO.

	Gasoline—Dealer T.W. Fire-Chief (*Regular*)	Indian (*3rd Grade*)	Gasoline Taxes
Dallas, Tex.	7.5	6.5	5.5
Ft. Worth, Tex.	7.5	6.5	5.5
Wichita Falls, Tex.	8.5	7.5	5.5
Amarillo, Tex.	8.5	7.5	5.5
Tyler, Tex.	8.5	7.5	5.5
El Paso, Tex.	11	10.5	5.5
San Angelo, Tex.	8.5	7.5	5.5
Waco, Tex.	8.5*	7*	5.5
Austin, Tex.	8.5	7.5	5.5
Houston, Tex.	8.5	7.5	5.5
San Antonio, Tex.	8.5	7.5	5.5
Port Arthur, Tex.	8.5	7.5	5.5

*Less 1c temporary allowance to all dealers.

(Continued on next page)

Tank Wagon Prices—Continued

S. O. IND.

	Red Crown Blue Crown (*Regular Grade*) Red Dealer Prices Crown Cons. T.W.	Red Crown	Blue Crown	Gaso-line Taxes	Kero-sine T.W.
Chicago, Ill.	11.6	9.6	9.1	4.5	10.6
Decatur, Ill.	11.6	9.6	8.7	4.5	10.3
Joliet, Ill.	11.9	10.3	9.2	4.5	10.6
Peoria, Ill.	11.7	9.9	9.7	4.5	10.4
Indianapolis, Ind.	11.6	10.1	9.6	5.5	10.1
Evansville, Ind.	11.4	9.9	8.6	5.5	9.9
South Bend, Ind.	12	10.5	10	5.5	10.5
Detroit, Mich.	11.4	9.9	9.4	4.5	10
Grand Rapids, Mich.	11.4	9.9	9.4	4.5	9.9
Saginaw, Mich.	11.4	9.9	9.4	4.5	9.9
Green Bay, Wis.	12.2	10.7	10.2	5.5	10.9
Milwaukee, Wis.	12.1	10.6	10.1	5.5	10.8
La Crosse, Wis.	11.9	10.4	9.9	5.5	10.6
Minneapolis - St. Paul.	11.9	10.4	9.9	5.5	10.6
Duluth, Minn.	12.2	10.7	10.2	5.5	10.9
Mankato, Minn.	11.9	10.4	9.9	5.5	10.6
Des Moines, Ia.	11.4	9.9	9.4	4.5	*10.1
Mason City, Ia.	11.7	10.2	9.7	4.5	*10.4
St. Louis, Mo.	11.0	9.5	9.3	*4.5	10.1
Kansas City, Mo.	11.0	9.5	8.6	*4.5	9.7
St. Joseph, Mo.	11.2	9.7	9.2	*4.5	9.9
Fargo, N. D.	12.9	11.4	10.9	5.5	11.6
Huron, S. D.	12.3	10.8	10.3	5.5	11
Wichita, Kans.	10.3	8.8	7.2	4.5	9.0

	Oleum Spirits	V.M.&P. Naphtha	Stani-sol	*Taxes
(Prices are base prices before discounts)				
Chicago	13.5	13.8	12.8	4.5
Detroit	15.8	15	16.3	4.5
K. C., Mo.	13.3	14.3	13.8	1.5
St. Louis, Mo.	13.7	14.7	13.2	1.5
Milwaukee	14.4	15.4	14.9	5.5
Minneap'ls	14.2	15.2	13.5	5.5

Fuel Oils T.W. Chicago

	Standard Heater Oil	Stanolex Furnace Oil
1-99 gals.	9.3	8.8
100-149 gals.	8.3	7.8
150 gals. & over	7.8	...
150-399 gals.	...	7.8
400 gals. & over	...	7.3

	Stanolex Fuel A	Stanolex Fuel C
1-749 gals.	6.5	6.0
750 gals. & over	5.75	5.25

Stanolex Furnace Oil

Other Points	1-99 gals.	100 gals. & over
Indianapolis	9.0	8.0
Detroit	8.7	7.7
Milwaukee	9.0	8.0
Minneapolis	9.1	8.1
St. Louis	8.4	7.4
Kansas City	8.1	7.1

***Taxes:** In gasoline tax column are included these city taxes—Kansas City, St. Joseph and St. Louis, 1c. Iowa kerosine prices are ex 3c state tax. In naphtha tax column are included 1.5c federal tax and state taxes.

State sales, occupation, consumer and use taxes to be added when applicable.

S. O. LA.

	Esso Gasoline (*Regular Grade*) Consumer Tank Wagon	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
New Orleans, La.	8.75	9.25	8.5	*9
Baton Rouge, La.	8.75	9.25	8.5	*9.5
Alexandria, La.	8.75	9.25	8.5	*9.5
Lafayette, La.	9	9.5	8.5	*9
Lake Charles, La.	9	9.5	8.5	*11
Shreveport, La.	8.5	9	8.5	*8
Knoxville, Tenn.	10.5	11	8.5	12.5
Memphis, Tenn.	8.90	9.40	8.5	10.5
Chattanooga, Tenn.	10.5	11	8.5	11
Nashville, Tenn.	10.5	11	8.5	10
Bristol, Tenn.	10.95	11.45	8.5	13.1
Little Rock, Ark.	9.5	10	8	10

*Louisiana kerosine prices are ex 1c state tax.

Discounts:

Esso Gasoline—To undivided dealers, 0.5c off dealer t.w.

S. O. OHIO

	*Sohio X-70 Gasoline (*Regular Grade*) Consumer T.W.	**Re-sellers	‡S.S.	Gaso-line Taxes	†Kero-sine T.W.
Ohio, Statewide	12	10	13.5	5.5	9.3
Akron	12	9.5	12.5	5.5	9.3
Canton	12	9.5	12.5	5.5	9.3
Cincinnati	12	9.5	12.5	5.5	9.3
Cleveland	12	9.5	12.5	5.5	9.3
Columbus	12	9.5	12.5	5.5	9.3
Dayton	12	9.5	12.5	5.5	9.3
Lima	12	9.5	12.5	5.5	9.3
Mansfield	12	9.5	12.5	5.5	9.3
Marion	12	9.0	12.0	5.5	9.3
Portsmouth	12	9.5	12.5	5.5	9.3
Toledo	12	9.5	12.5	5.5	9.3
Youngstown	12	9.5	12.5	5.5	9.3
Zanesville	12	9.5	12.5	5.5	9.3

Aviation Gasoline—Statewide

	Consumer T.W.	Gasoline Taxes
Sohio Aviation Gasoline clear Spec. AN-F-22	14.5	5.5
Esso Ethyl Aviation 73 Oct.	15.5	5.5
Esso Ethyl Aviation 80 Oct.	16.5	5.5
Esso Ethyl Aviation 87 Oct.	17.5	5.5
Esso Ethyl Aviation 91 Oct.	17.5	5.5
Esso Ethyl Aviation 100 Oct.	24.5	5.5

	†Naphtha—T.W. Statewide	Lucas County
S. R. Solvent	13.5	13.5
D. C. Naphtha	14.5	14.25
V.M.&P. Naphtha	14.5	14.25
Varnolene	14.5	14.25
Sohio Solvent	14.5	14.25

Fuel Oils—T.W.	No. 1	No. 2	No. 3	No. 4
Ohio, Statewide	8.3	8.3	7.8	*7.55

*Renown (third-grade) prices are same as X-70 unless otherwise noted.

**Except authorized agents.

†Kerosine prices are ex 1c state tax. Naphtha prices are ex 1.5c federal & 4c state tax.

‡Prices at company-operated stations.

††Statewide prices are subject to exceptions other than those shown.

Discounts:

Esso aviation—on contract to hangar operators and resellers, 2c off consumer t.w.

*For Cleveland area only. Full compartment hose dumps.

Fuel oils—Statewide prices are for t.w. & drum deliveries of 50 gals. or more; prices for deliveries of less than 50 gals. are 0.5c higher.

Naphthas—to contract consumers off t.w. prices—Statewide: 300 to 999 gals., 0.5c; 1000 to 2499 gals., 0.75c; 2500 to 4999 gals., 1c; 5000 or more gals., 1.5c. Lucas County: Less than 50 gals., tank wagon price, 50 to 249 gals., 0.5c; 250 to 499 gals., 1c; 500 gals. or over, 1.5c.

HUMBLE OIL

	Humble Thriftane (*Regular Grade) *Tank Wagon	Re-tail	Humble Thriftane (*Third Grade) *Tank Wagon	Re-tail	Gaso-line Taxes
Dallas, Tex.	7.5	10.5	6.5	10.5	5.5
Ft. Worth, Tex.	6.5	9.5	6	7.5	5.5
Houston, Tex.	8.5	12.5	7.5	10.5	5.5
San Ant., Tex.	8.5	12.5	7.5	10.5	5.5

Consumer tank wagan prices are 1c per gal. above the dealer tank wagon prices.

	Kerosine *Tank Wagon	Retail
Dallas, Tex.	7	10
Ft. Worth, Tex.	7	11
Houston, Tex.	8	11
San Antonio, Tex.	7	10

*To all classes of dealers & consumers

Canada

PRICES OF IMPERIAL OIL, LTD.

Per Imperial Gallon, which is 1.2 U. S. Gallons

IMPERIAL OIL

	3-Star Imperial Gasoline (*Regular Grade*) †Gasoline T.W.	*Gasoline Taxes	Kero-sine T.W.
Hamilton, Ont.	16.5	11	18
Toronto, Ont.	16.5	11	18
Brandon, Man.	20.5	10	23
Winnipeg, Man.	20.0	10	22.5
Regina, Sask.	17.5	10	20
Saskatoon, Sask.	20.3	10	22.8
Edmonton, Alta.	18.4	10	20.9
Calgary, Alta.	15.5	10	18
Vancouver, B. C.	15	10	24
Montreal, Que.	16.5	11	17.5
St. John, N. B.	16	13	19
Halifax, N. S.	16	13	19

*Includes 3c Federal, and Provincial taxes.

†To divided & undivided dealers.

Absorption Gasoline—No. 26 R.V.P.—$2.28

Gasoline prices effective Oct. 7.

ATLANTIC REFINING

	Atlantic White Flash (*Regular Grade*) Commercial T.W.	Dealer T.W.	Gaso-line Taxes	Kero-sine T.W.
Philadelphia, Pa.	10.2	10.7	5.5	12.25
Pittsburgh	10.1	10.6	5.5	12.1
Allentown	10.7	11.2	5.5	12.6
*Erie	10.1	10.6	5.5	12.1
Scranton	10.7	11.2	5.5	12.6
Altoona	10.7	11.2	5.5	12.6
Emporium	10.1	10.6	5.5	12.1
Indiana	10.7	11.2	5.5	12.6
Uniontown	10.1	10.6	5.5	12.1
Harrisburg	10.7	11.2	5.5	12.6
Williamsport	10.7	11.2	5.5	12.6
Dover, Del.	....	11.2	5.5	12.6
Wilmington, Del.	....	10.7	5.5	12.1
Boston, Mass.	....	10.9	4.5	....
Springfield, Mass.	....	11.8	4.5	....
Worcester, Mass.	....	11.5	4.5	....
Fall River, Mass.	....	11	4.5	....
Hartford, Conn.	....	11.6	4.5	....
New Haven, Conn	....	11	4.5	....
Providence, R. I.	....	11	4.5	....
Atlantic City, N. J.	....	10.7	4.5	10
Camden, N. J.	....	10.7	4.5	10
Trenton, N. J.	....	10.7	4.5	10
Annapolis, Md.	....	11.05	5.5	10.8
Baltimore, Md.	....	10.45	5.5	9.8
Hagerstown, Md.	....	11.55	5.5	10.3
Richmond, Va.	....	11.25	6.5	12.3
Wilmington, N. C.	....	11.15	7.5	11.6
Brunswick, Ga.	....	10.1	7.5	10.6
Jacksonville, Fla.	....	10.1	8.5	11.6

*Retroactive to Sept. 1.

	Mineral Spirits T.W.†	V.M.&P. T.W.†
Philadelphia, Pa.	11	12.5
Lancaster, Pa.	12	13.5
Pittsburgh, Pa.	12.5	13.5

	Fuel Oils—T.W. 1	2	3	5	6
Phila., Pa.	10.1	9	9	5.76	5.04
Allentown, Pa.	10.6	9.3	9.3	....	....
Wilmington, Del.	10.1	9	9	....	....
Springfield, Mass.	10.2	9.4	9.4	....	....
Worcester, Mass.	10.2	9.3	9.3	....	....
Hartford, Conn.	10.5	9.2	9.2	....	....

‡Does not include 1c Georgia kerosine tax.

†Mineral Spirits prices also apply to Stoddard Solvent; V.M.&P. prices also apply to Light Cleaners Naphtha.

Discounts:

Gasoline—to undivided dealers, 0.5c off dealer t.w. except Georgia & Florida dealer t.w. and undivided dealer t.w. prices are same.

Kerosine—Thru Penna. & Delaware, 2c off t.w. price on t.w. deliveries of 25 gals. or more at one time.

S. O. KY.

	Crown Gasoline (*Regular*) Standard (*Third Grade*) †Net Crown	Gaso-line Taxes	Kero-sine T.W.
Covington, Ky.	9.5	6.5	9.3
Lexington, Ky.	10.5	6.5	9.3
Louisville, Ky.	10	6.5	8.8
Paducah, Ky.	10	6.5	8.8
Jackson, Miss.	10	7.5	*9
Vicksburg, Miss.	9.5	7.5	*8.5
Birmingham, Ala.	10	*8.5	9
Mobile, Ala.	9	*9.5	8.5
Montgomery, Ala.	10	*9.5	*10
Atlanta, Ga.	11.1	7.5	*11.6
Augusta, Ga.	11.1	7.5	*11.1
Macon, Ga.	11.1	7.5	*11.6
Savannah, Ga.	10.1	7.5	*10.6
Jacksonville, Fla.	10.1	8.5	9.6
Miami, Fla.	10.1	8.5	9.6
Pensacola, Fla.	9	*9.5	8
Tampa, Fla.	10.1	8.5	9.6

*Taxes: In tax column are included these city and county gasoline taxes: Mobile, 2c city; Birmingham, 1c city; Montgomery, 1c city and 1c county; Pensacola, 1c city. Georgia and Montgomery, Ala. have 1c kerosine tax, Mississippi 0.5c, included in above prices.

†Consumer t.w. prices are same as net dealer prices.

Prices are retroactive to Sept. 1.

SOCONY VACUUM

	Socony Mobilgas (*Regular Grade*) Com. Cons. T.W.	Undiv. Dlr. T.W.	Gaso-line Taxes
New York City			
Manhattan & Bronx	10.1	10.6	*5.5
Kings & Queens	10.1	10.6	*5.5
Richmond	9.7	10.2	*5.5
Albany, N. Y.	9.9	10.4	5.5
Binghamton, N. Y.	11	11.5	5.5
Buffalo	9.6	10.1	5.5
Jamestown, N. Y.	9.8	10.3	5.5
Mt. Vernon, N. Y.	10.1	10.6	5.5
Plattsburg, N. Y.	11	11.5	5.5
Rochester, N. Y.	10.8	11.3	5.5
Syracuse, N. Y.	10.5	11	5.5
Bridgeport, Conn.	10	10.5	4.5
Danbury, Conn.	10.5	11	4.5
Hartford, Conn.	10.6	11.1	4.5
New Haven, Conn.	10	10.5	4.5

(Continued on next page)

Atlantic Coast

(Prices are of refiners, FOB their refineries & their tanker terminals, & of tanker terminal operators FOB their terminals)—Prices in Effect Dec. 4.

MOTOR GASOLINE

District	72 Oct. (ASTM)	70-74 oct. (ASTM)
N. Y. Harb.	Not made	9.075
N. Y. Harb., barges	"	8.975
Albany	"	9.175
Philadelphia	"	9.075
Baltimore	"	8.825
Norfolk	"	8.575
Wilmington, N. C.	"	8.175
Charleston	"	8.175
Savannah	"	7.845
Jacksonville	"	7.845
Miami	"	7.845
Tampa	"	7.845
Pensacola	"	6.875 (1)
Mobile	"	6.62 – 6.745
New Orleans	"	6.125(1)
Portland	"	9.375
Boston	"	9.275
Providence	"	9.275

FUEL OILS

	KEROSINE and/or NO. 1 FUEL	No. 2	No. 3	No. 5	No. 6
N. Y. Harb.	7.1	6.7	6.7	$1.85–$1.95 (a)	$1.77
N. Y. Harb., barges	7	6.6	6.6	....	....
Albany	7.3	6.8	6.8 (2)	....	$1.97 (1)
Philadelphia	7.2	6.7	6.7	$1.98	$1.77
Baltimore	7.2	6.7	6.7	$1.85 (1)	$1.77
Norfolk	7.1	6.7	6.7 (1)	$1.85 (1)	$1.77
Wilmington, N. C.	6.75	6.4	....	....	....
Charleston	6.9	6.4 (2)	....	$1.80 (1)	$1.72 (2)
Savannah	6.55	5.75 (1)	....	....	$1.72 (1)
Jacksonville	6.55	5.75	....	....	$1.72
Miami	6.55	5.75 (1)	....	....	....
Tampa	6.55	5.75	....	....	$1.62
Pensacola	4.8 (1)	....	....	....	....
Mobile	4.75 (2)	....	....	....	....
New Orleans	4.125–4.25 (2)	3.75 (2)	....	$1.27 (1)	$0.97
Portland	7.3	6.8	6.8 (2)	....	$1.77
Boston	7.2	6.7	6.7 (2)	$1.95 (2)	$1.77
Providence	7.2	6.7	6.7 (2)	$1.90 (1)	$1.77

(a) Price is for straight-run low pour, test No. 5 ($1.95)

Pacific Export

In Ship's Bunkers, or deep tank lots:

Prices in Effect	Dec. 4	Nov. 27
Diesel Fuel, Pac. Spec. 200	$1.45	$1.45
Grade C fuel, Pac. Spec. 400	$1.10	$1.10

Seaboard Export Coastwise Prices

	Bunker C Fuel Ships' bunkers (Ex Lighterage)	Diesel Oil Ships' bunkers (Ex Lighterage)	Diesel Oil Shore Plants	Gas House Gas Oil 28-34 Gravity
New Haven	$1.77	.....	.....	.....
N. Y. Harbor	$1.77	$2.78	6.7	6.8 (2)
Albany	$1.97 (1)	$2.98 (1)	6.8 (1)	7 (1)
Philadelphia	$1.77	$2.78	....	....
Baltimore	$1.77	$2.78	6.7 (1)	6.7 (1)
Norfolk	$1.77	$2.78	6.7 (1)	6.7 (1)
Charleston	$1.72 (2)	$2.78 (2)	6.7 (1)	6.7 (1)
Savannah	$1.72 (1)	$2.62 (1)	....	....
Jacksonville	$1.72	$2.62 (2)	....	....
Tampa	$1.62	$2.62	....	....
New Orleans	$0.97	$1.65 (1)	4 (1)	....
Portland	$1.77	$2.86 (2)	6.8 (1)	6.9 (1)
Boston	$1.77	$2.78	6.7 (2)	6.8 (2)
Providence	$1.77	$2.78 (2)	6.7 (1)	6.8 (1)

Bunker "C" when from Navy storage at New York and Norfolk to W.S.A. ships .05c discount.

Tank Wagon Prices (Continued)

SOCONY VACUUM

	Socony Mobilgas (*Regular Grade*) Com. Cons. T.W.	Undiv. Dlr. T.W.	Gasoline Taxes
Bangor, Me.	10.7	11.2	5.5
Portland, Me.	10.3	10.8	5.5
Boston, Mass.	9.9	10.4	4.5
Concord, N. H.	11.4	11.9	5.5
Lancaster, N. H.	12	12.5	5.5
Manchester, N. H.	11.3	11.8	5.5
Providence, R. I.	10	10.5	4.5
Burlington, Vt.	10.9	11.4	5.5
Rutland, Vt.	11	11.5	5.5

	Mineral Spirits T.W.	V.M.&P. T.W.
Buffalo, N. Y.	12.4	13.6
New York City	11	12
Rochester, N. Y.	13.2	14.4
Syracuse, N. Y.	14	....
Boston, Mass.	12	13
Bridgeport, Conn.	†16.3	†17.3
Hartford, Conn.	†16.3	†17.3
Providence, R. I.	13	14

	Kerosine Yard	Kerosine T.W.	Mobilfuel Diesel T.C.	Mobilfuel Diesel T.W	Mobilheat Fuel Yard	Mobilheat Fuel T.W.
New York:						
Manhat'n & Bronx	7.5	10.3	...	9.3	7.1	9
Kings & Queens	7.5	10.3	...	9.3	7.1	9
Richmond	7.5	10.3	...	...	7.1	9.0
Albany	7.5	9.8	6.8	9.3	7	9
Binghamton	8.9	11.2	...	10.7	8.4	10.2
Buffalo	8.1	10.4	7.5	9.8	7.7	9.5
Jamestown	8.2	10.5	...	10.1	7.8	9.5
Mt. Vernon	7.6	10.3	...	9.4	7.2	9
Plattsburg	8.1	10.4	...	9.9	7.6	9.4
Rochester	8.7	11	7.9	10.2	7.9	9.7
Syracuse	8.5	10.8	7.8	10.1	7.8	9.6
Conn.:						
Bridgeport	7.8	10.3	...	....	7.3	9.0
Danbury	8.2	10.8	...	....	7.8	8.5
Hartford	8.0	10.5	...	9.5	7.4	9.2
New Haven	7.5	10.3	...	9.3	7.1	9.0
Maine:						
Bangor	7.9	10.2	7.4	9.7	7.4	9.1
Portland	7.5	10.2	6.8	9.3	7	9
Mass.:						
Boston	7.8	10.6	6.7	9.2	7.1	9
N. H.:						
Concord	8.4	10.7	...	....	8.2	10
Lancaster	9.5	11.8	...	....	9.2	11
Manchester	8.5	11.1	...	....	7.9	9.7
R. I.:						
Providence	7.8	10.1	6.7	9.2	7.1	9.0
Vermont:						
Burlington	8.1	10.4	7.5	9.8	7.5	9.2
Rutland	8.3	10.6	...	10	7.7	9.5

*Does not include 1% city sales tax applicable to price of gasoline (ex tax).

†In steel barrels.

Discounts: Diesel—On t.w. deliveries, 0.5c for at least 400 gals.; 1c for full tank truck.

EXPORT PRICES

Prices Effective Dec. 4

	Mexican Gulf Ports U. S. Dollars per Bbl. Bunker C	Diesel
Tampico	$0.97	$1.65
Veracruz	0.97	....
Coatzacoalcos	0.97	1.65
Pacific Coast		
Guaymas	$1.50	$3.22
Mazatlan	1.50	3.22
Acapulco	1.50	2.89
Manzanillo	1.50	2.89
Salina Cruz	1.50	2.89

Gulf Coast

Prices in Effect Dec. 4

MOTOR GASOLINE	New Orleans & Lower Mississippi to Baton Rouge Tank Cars	New Orleans & Lower Mississippi to Baton Rouge Barges	Texas Gulf Coast South of New Orleans Tank Cars	Texas Gulf Coast South of New Orleans Barges	CARGOES Domestic & Export From all Gulf Ports
Leaded (oct. by ASTM)					
76 oct.	6.75	6.5	6.5 – 6.75	6.75	6.75
70-74 oct.	6 – 6.125	5.625	5.625–6.375 (a)	5.625	5.625
63-65 oct.	....	....	....	....	....
Unleaded 70 oct.	....	....	....	....	5.75
67-68 oct.	....	....	....	....	5.5
65 oct.	....	....	....	....	5.25
60 oct.	....	....	....	....	5
KEROSINE & LIGHT FUELS					
41-43 w.w. kero.	4.125– 4.25	4.125	4.125– 4.25	4.125	4.125
42-44 w.w. kero.	....	....	4.125	4.125	4.125
No. 2 fuel oil	3.75	3.75	3.75 – 4	3.75	3.75
DIESEL & GAS OILS					
(In diesel index No.)					
Below 43 di.	....	....	....	....	....
43-47 di.	....	....	....	....	4
48-52 di.	4	4	4	....	4
53-57 di.	4.125	....	4.125	4.125	4.125
58 and above	4.25	....	4.25	....	4.25

(a) 5.625c for Dist. 1 and 5.875–6.375c for other districts.

NOTE: Above products in Truck Transports of 2,400 gal. and over ½c above Tank Car Prices.

Heavy Fuels & Bunker Oil (at all Gulf Ports) Heavy Diesels	In Cargoes	In Ship's Bunkers (Ex Lighterage)
Below 28 API Grav.	....	$1.35
28 & above API Grav.	....	$1.65
Bunker C Oil	$0.97	$0.97

Mid-Continent Lubes

(At Gulf; in packages, FAS.; in bulk, FOB terminals).

Prices in Effect Dec. 4

	Steel Drums	Bulk
Bright Stock		
D color, Vis at 210°		
200 vis.	....	....
150 vis., 0-10 p.p.	32.65 (1&a)	24.8 (1)
100 vis., 0-10 p.p.	....	....
100 vis., 10-25 p.p.	....	....
Neutral—No. 3 color		
200 vis., 0-10 p.p.	....	— —

(A) FAS at New Orleans.

Wax

(Melting points are AMP, 3° higher than EMP Prices are FOB refinery and do not include bag. freight or export differentials).

Prices in Effect Dec. 4

Crude Scale	New Orleans Export	N. Y. Domestic	N. Y. Export
124-6 Yellow	4.25(1)	....	4.25(1)
122-4 White	....	4.25(2)	4.25(2)
124-6 White	4.25(1)	4.25	4.25
Fully Refined:			
123-5	5.2(1)	5.2(2)	5.2(1)
125-7	5.2(1)	5.2(2)	5.2(1)
128-30	5.6(1)	5.6	5.6(1)
130-32	5.85(1)	5.85(2)	5.85(1)
133-5	6.15(1)	6.15	6.15(1)
135-7	6.4(1)	6.4(1)	6.4(1)

Naphtha

Prices in Effect Dec. 4

	V.M.&P. Naphtha	Mineral Spirits
New York Harbor	11 (2)	10
Philadelphia	11 (2)	10
Baltimore	10.5 (2)	9.5
Boston	11.5 (2)	10.5
Providence	11.5 (1)	10.5 (2)

CLASSIFIED

For Sale

FOR SALE: 1 Int. 38-D40 Tractor K7 Motor; 1 Int. 40-D40 Tractor C.O.E. K7 Motor; 1 Fruehauf 3545 Gal. 3-compt. Semi-Trailer; 1 Fruehauf 3600 Gal. 3-compt. Semi-Trailer. John Dailey, Moss Point, Miss. Phone 5111.

TWENTY 800 gallon Tanks, built for Bituminous distributors, with 2 8" double return heating flues, 18" manhole opening, no cover, 7 gauge heads, 10 gauge bodies, oval 4' high, 71" wide x 82" long. Midway Resales Company, 439 Pillsbury Ave., St. Paul 4, Minn.

FOR SALE

1½" Heavy Duty Synthetic Hose at $.50 per foot, couplings extra $2.79 per set. Single and 2 post hydraulic lifts now available.

Carlton W. Hasselback,
53 Columbia Parkway, Buffalo 10, N. Y.

NOTICE

We can supply 200 grade III recapped and used tires per week.

Lorain Avenue Tire Co.,
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FOR SALE

Used Steel Tanks 500 to 1,000,000 gallons each.
2", 2½" and 3" Brodie Meters, 2" Blackmer Rotary Pumps, valves, fittings and pipe.

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608 Empire Bldg., Cleveland 14, Ohio
Phone Main 7667

FOR SALE
New and Reconditioned
IRON and STEEL
VALVES
Tested and Guaranteed
Also Fittings
APEX IRON & METAL CO.
2204 South Laflin St.
Chicago 8, Illinois

FOR SALE

1—4300 Gal. Fruehauf 3-compt. tank.
1—4100 Gal. Fruehauf 2-compt. tank.
1—4220 Gal. Great Dane 3-compt. tank.
1—WA 20-White tractor.
1—WA 22-White tractor.
All are in good condition and running every day. Apply—

J. E. Boswell, Greensboro, Ga.

STORAGE TANKS & TRUCK TANKS

6—10,000 gal. tanks (7' x 34')
2— 6,000 gal. tanks (8' x 16')
1— 2,500 gal. tank (7' x 9')
1— 2,000 gal. tank (5'4" x 12')

TRUCK TANKS

1—1,000 gal. tank complete with meter and equipment.
1—1,500 gal. tank, 2 compt.
1—1,000 gal. tank, 3 compt.
1— 750 gal. tank, 1 compt.
1—2,400 gal. tank, 3 compt.
1—3,600 gal. aluminum trailer tank.

METERS

2—3" Buffalo bulk meters also several smaller meters, pumps & reels.

These tanks and equipment are in excellent condition and are ready to install—act quick.

D. & C. Equipment Co.
10 Edwards St. Hartford, Conn.
Phone: 7-5000

Wanted to Buy

WANTED TO BUY twenty-five to fifty gasoline underground storage tanks of three to five thousand gallon capacity. Also machine for bottling motor oil. Apply to—Drawer 191, High Point, N. C.

Situations Open

MECHANICAL OR CIVIL ENGINEER. Large midwestern oil company requires graduate M.E.'s or C.E.'s for refinery design, layout, and inspection work, with a real post war future. Write Box 497 giving qualifications and experience if available under WMC regulations.

WANTED—A man with technical and engineering training to prepare lubrication recommendations and technical data on industrial petroleum products. Preferably a man who can write articles on lubrication and make machinery builders' recommendations for lubricating oils and greases. In applying, give information as to educational training, practical experience and age. Box No. 481.

SALES MANAGER WANTED

For established and responsible independent refinery in South. Party experienced in waterway transportation preferred. Age 35-45. Excellent opportunity for man with energy and resourcefulness. Apply—

Box No. 496

WANTED SALESMANAGER

For large independent distributor in metropolitan New Jersey territory. Must be aggressive with experienced background. Good salary for right party. Applicants state full details together with age. Reply—

Box No. 476

Grease Formulas

FORMULAS WANTED

for making soda base lubricants water repellent, with samples and full particulars. Also want information concerning additives for making finished soda base lubricants water resistant.

Box No. 494

For Sale

FOR SALE

1—4100 gallon, 2 compartment semi-tank trailer with White Tractor, new motor.
1—4000 gallon, 2 compartment semi-tank trailer with Reo Tractor.
Both of these pieces are in excellent condition and working every day.

Liquid Heat Fuel Company
P.O. Box 10, Mishawaka, Ind.
Phone: 5-1600

FOR SALE

1—1941 K8 International Tractor, newly painted and in excellent mechanical condition, with good rubber and spare tire.

1—3500 Gal. Trailmobile Semi Tank Truck with good rubber and spare tire.

Extra parts for both. Must be sold as one unit. Total cash price $3000.00.

Mr. E. Lee Brown,
B. & W. Oil Co., Union City, Mich.
Telephone 2241

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22 years experience all phases Petroleum Industry. Comprehensive knowledge and above the average ability to handle position of importance in any of the following:
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THE DETROIT TESTING LABORATORY
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Advertisements set in special type or with border—$5.00 per column inch.

Copy must reach us not later than Saturday preceding date of issue.

All classified advertisements are payable in advance.

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ABOUT OIL PEOPLE

J. D. **Riggs** of Madison, S. D., didn't want to miss the 26th annual convention of South Dakota Independent Oil Men's Assn. at Mitchell on Nov. 27-28 so he came a week early. It seems that his friend, **R. A. Hyde** of Pipestone had arranged for hotel accommodations and got the dates mixed for Mr. Riggs found himself at the wrong convention—a gathering of the state's school ma'rms.

° ° °

Art **Anderson,** oil jobber of Sioux Falls, S. D., was re-elected state representative for a third term on Nov. 7. He received more votes than any other man running for any office in Minnehaha County.

° ° °

The birds for a pheasant dinner following the Nov. 26 annual meeting of South Dakota Petroleum Transporters Assn. and for a group of special guests attending South Dakota Independent Oil Men's Assn. convention on Nov. 29 at Mitchell, were provided by a committee of local nimrods—**Hal Taylor, Leonard Wudel, Sheldon Shaw, Leo Boehnen, Harold Lau, Harold Miller, E. J. Sherwood** and **Earl Mayhew.** Just to prove that pheasant hunting is pleasant hunting in that state, the group went out one afternoon and brought back 39 birds.

° ° °

Dr. W. P. Edmunds, former area director for WMC in Cleveland, has opened an office in Cleveland as an industrial relations consultant. Dr. Edmunds for 13 years was manager of industrial relations for the Standard Oil Co. of Ohio. He was the organizer of the Cleveland Labor Stabilization Committee and served two months with the Army Air Forces on a special assignment before becoming area director.

° ° °

Jack Willing is now the sole owner of U-Save Stations in Cleveland, having purchased the interest of his partner Ray Frantz. The U-Save Stations system was organized by Messrs. Frantz and Willing 8½ years ago when they resigned as sales executives from the Cities Service Oil Co. Both are well known in the Midwest. Mr. Frantz has not announced his future plans.

° ° °

On Dec. 12, Detroit Oil Men's Club will elect officers and two resident directors for 1945. The nominating committee has made the following nominations: For president, Robert Terry; vice president, Howard Johnson, Curtis Mower; secretary, Le Roi Buzette, R. D. Van Velzor; treasurer, J. R. Charett, V. A. Christie; directors, Glenn Allen and J. O. Lefton, J. D. Hadley and George McWood, E. E. Ledbetter and R. B. Richardson, and Hayden R. Williams.

Under the by-laws, **P. F. Edwards** automatically becomes a director for the coming year and resident directors, **Howard MacGready** and **Clem Theisen,** and non-resident directors, **Jack Fleckenstein** and **James Dunnigan** have an additional year on the board. The election will be preceded by a dinner.

° ° °

Skelly Oil Co. opened a new marketing division office in Dallas, Texas, on Dec. 1, **E. F. Underwood,** the sales manager of wholesale sales, announces. **B. A. Pruitt,** recently assistant division manager, Minneapolis division, has been appointed division manager. **W. R. Spindell** is being transferred from the Longview, Tex., refinery to become Mr. Pruitt's assistant. **Harry H. Jones** has been named wholesale representative.

° ° °

For reasons which might be a military secret, employes of the Trenton Refinery, White Star Division of Socony-Vacuum Oil Co., have an organization called the Mustache Club.

Full fledged members are those who have succeeded in growing mustaches. Those on probation have to wear pseudo mustaches at meetings until their real mustaches have grown.

Charter members include **Lee H. Barton, Milton A. Bunte, Floyd J. Rue, Anthony F. Wimmer, Daniel J. Keffer, Hulbert Q. Hall, Fred J. Henry, John A. Yope, C. Gartrelle Penn, Cecil H. Malone, Leon A. Osborn, Wesley W. Hammack, L. A. Dollahan, Con N. Wollney, Lawrence Appleton** and **Richard F. Martz.**

Floyd J. Rue for good measure, also has grown a Kentucky colonel style goatee.

Coast Guard Shield of Honor Awarded to Socony-Vacuum Refinery

Vice Admiral R. R. Waesche, commandant of the United States Coast Guard, paid high compliment to the oil industry and to Socony-Vacuum Oil Co. particularly for its war service record, when he presented the company recently with the Coast Guard Shield of Honor for meritorious wartime service. Admiral Waesche cited, especially, the fire fighting school established by the company at its East Chicago refinery by William Hildebrandt, refinery manager. Bryon S. Reid, general manager of Socony-Vacuum, accepted the honor on behalf of the employes of the company. Snapped during the ceremony, above, left to right, were: Mr. Reid, Mr. Hildebrandt; Admiral Waesche; Capt. R. W. Dempwolf, U. S. Coast Guard and Comdr. P. G. Petterson, U. S. Coast Guard

"Uncle Frank" Phillips celebrated his 71st birthday in a big way Nov. 28. More than 2000 Bartlesville, Okla., employes of Phillips Petroleum Co. swarmed the lawn and streets surrounding his home and awakened him from his usual after-lunch nap singing "Happy Birthday To You". A scroll bearing a resolution of appreciation was presented to the chairman of the board and founder of the company by one of Phillips' veteran employes. **Judge R. H. Hudson** and "Uncle Frank" declared the remainder of the day a holiday.

* * *

Alan G. Skelton, former librarian of the School of Geology at the University of Oklahoma, has joined the Tulsa headquarters staff of the Mid-Continent Oil & Gas Assn. and will have charge of the association's statistical and information services and library. Before coming to the association Mr. Skelton was a member of the staff of the *Oklahoma Geological Survey.*

* * *

Alec M. Crowell, director of the Arkansas Oil & Gas Commission since 1938, resigned Dec. 1 to enter private practice in Shreveport assisting operators with problems for solution with the regulatory bodies of Arkansas, Louisiana, Mississippi, Texas and the federal government. A graduate mechanical engineer, Mr. Crowell received a B.S. degree from the University of North Carolina and did further study at the Universities of Oklahoma and Kansas. He was associated with Empire Oil & Refg. Co. and later with Del Rey Oil & Refg. Co. as petroleum engineer, and was supervisor of field engineering and research for the Texas Railroad Commission from 1933 to 1938. Organizing the present Arkansas Oil & Gas Commission, Mr. Crowell drafted the state's conservation law.

He is a member of the A.P.I., A.I.M.M.E., and American Military Engineers.

* * *

H. G. (Pat) Henderson, petroleum engineer for Severns Drilling Co., has been elected chairman of Dist. 18 of the conservation committee of California Oil Producers.

* * *

Alex N. Campbell, formerly with NATIONAL PETROLEUM NEWS' Los Angeles news bureau, last week was passing out cigars in celebration of the birth of a daughter, Suzanne. Alex, oil editor of the *Los Angeles Herald-Express* and a Torrance oil operator, already has a son, Alexander Nye Campbell, 2.

* * *

Charles S. Rosenthal, general manager and vice president of Apex Motor Fuel Co. and president of the Illinois Petroleum Marketers' Assn., will leave for Florida within the next week for a two months rest on the advice of his physician.

* * *

R. C. Ward, regional credit manager for Sun Oil at Toledo, was chosen chairman of the Speaker's Bureau for the Sixth War Loan Drive in the Northwestern Ohio area.

62½% For War Bonds

J. A. Gravois

NORCO, La. — Those who complain about nothing being left after all the payroll deductions have been provided for, might be reminded that **J. A. Gravois,** (above), a laboratory tester at the Shell Oil Co.'s refinery here puts 62½% of his salary into war bonds. And it is not just a "stunt" either. He has been doing it for over a year.

This plant, which produces components for high-octane aviation gasoline, has other high percentage buyers. One woman employe, **Mrs. M. C. Hosea,** is putting aside 35% of her pay as her bit. Her participation is followed closely by **A. L. Cambre,** who has deductions of 30%.

The average contribution throughout the plant is 14%. One hundred per cent of the employes participate in war bond buying.

James O'Brien, wholesale salesman for Sun Oil Co. in the Cleveland division, has retired after 19 years of service.

* * *

The Navy now has the "Real McCoy", in the person of **R. T. McCoy,** Dodge City, Ia., jobber. Mr. McCoy, better known as the "Real McCoy", was recently commissioned a Lieut. (jg) in the Navy. He is now a deck officer in the Indoctrinational school, Plattsburgh, N.Y. In his absence the "Real McCoy's" oil business will be operated by **Walter Gregg.**

* * *

Whitney Weinrich has joined the research department of the Phillips Petroleum Co. at Bartlesville, Okla., in its engineering and development division. Mr. Weinrich recently resigned his position with the Refining Division of PAW in Washington. Previously he was associated with Gulf Research & Development Co., in Pittsburgh, where he was head of the chemical engineering and process laboratories.

* * *

M. H. Robineau, president, and other officials of the Frontier Refining Co. were recently honored by the Cheyenne Chamber of Commerce at a testimonial dinner. Club officials paid tribute to the importance of the refinery to Cheyenne and Wyoming.

Frank Cross, secretary-treasurer of Sun Oil Co., is making personal gifts of two Bibles which are to be placed on each Sun Oil tankship. One Bible is to be kept in the captain's quarters, and the other in the quarters of the chief engineer on each ship. They are to be readily available to any crew member who wishes to make use of them.

* * *

Among newly elected officers of the Tulsa Traffic club are **J. C. Scheidel,** district manager of North American Car Corp., president, **W. F. Gumaer,** agent of Lee Way Motor Freight, Inc., and **J. B. Fairfield,** manager of sales and traffic of Sunray Oil Corp., directors.

* * *

W. S. Grant, Union Oil Co.'s area manager at Long Beach, Cal., was recently elected president of that city's Chamber of Commerce. Mr. Grant has been a member of the Chamber for over three years, holding positions as director and director-at-large prior to achieving his present office. In addition he is president of the Long Beach Shrine Club.

* * *

The Drilling Contractor has made its bow as the official publication of the American Assn. of Oilwell Drilling Contractors. The first issue contains editorial opinion and comment, technical discussions and other data of interest to the association members. **Brad Millis** is editor, and **M. Marett,** associate editor.

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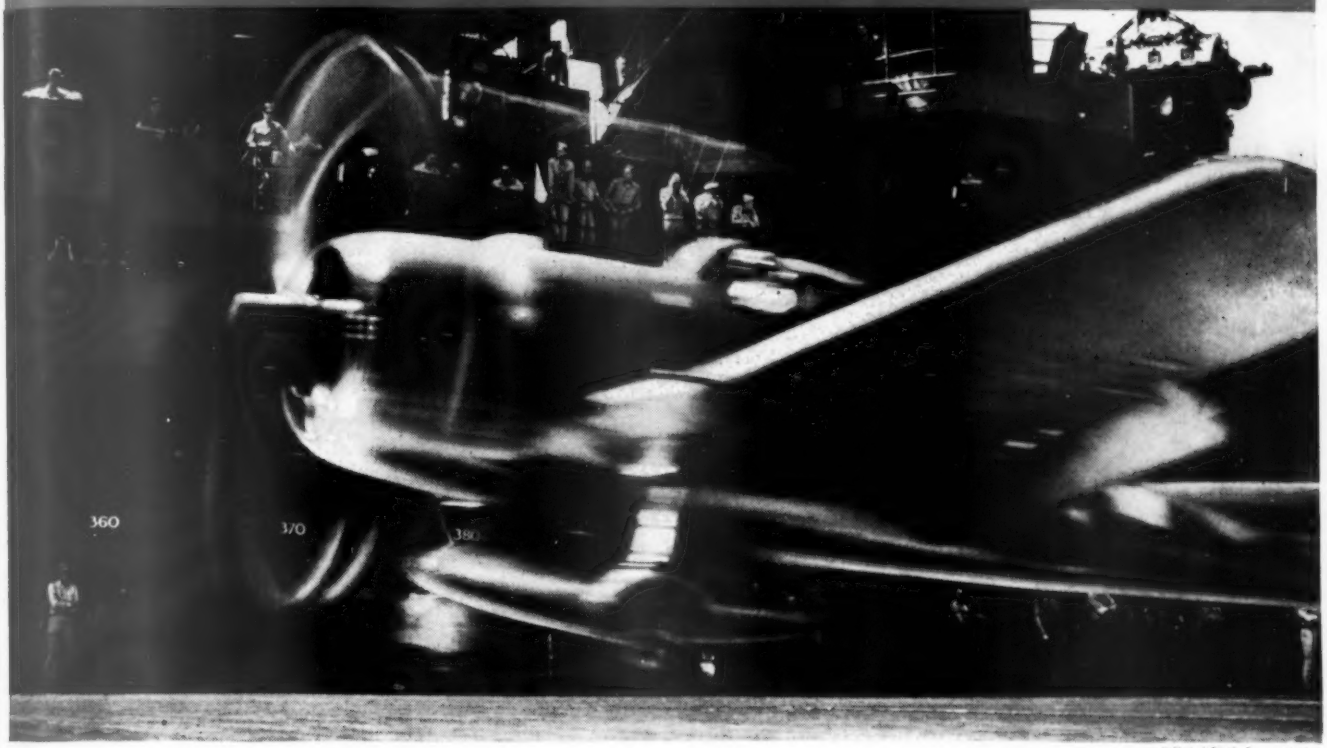
Super Fuel Ingredients boost Take-off, Climbing and Carrying Power of U. S. Planes . . .



Official U.S. Navy Photo

They Fight – America will Ride – on

"FLYING HORSEPOWER"

EVEN THE eye of a high-speed camera can't catch a close-up of "Flying Horsepower" in action...

But it's a very real thing to our fliers! For it gives them great combat advantages — faster take-offs and climb, far wider cruising range.

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NATIONAL PETROLEUM NEWS

Monthly Technical Section Devoted to

REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

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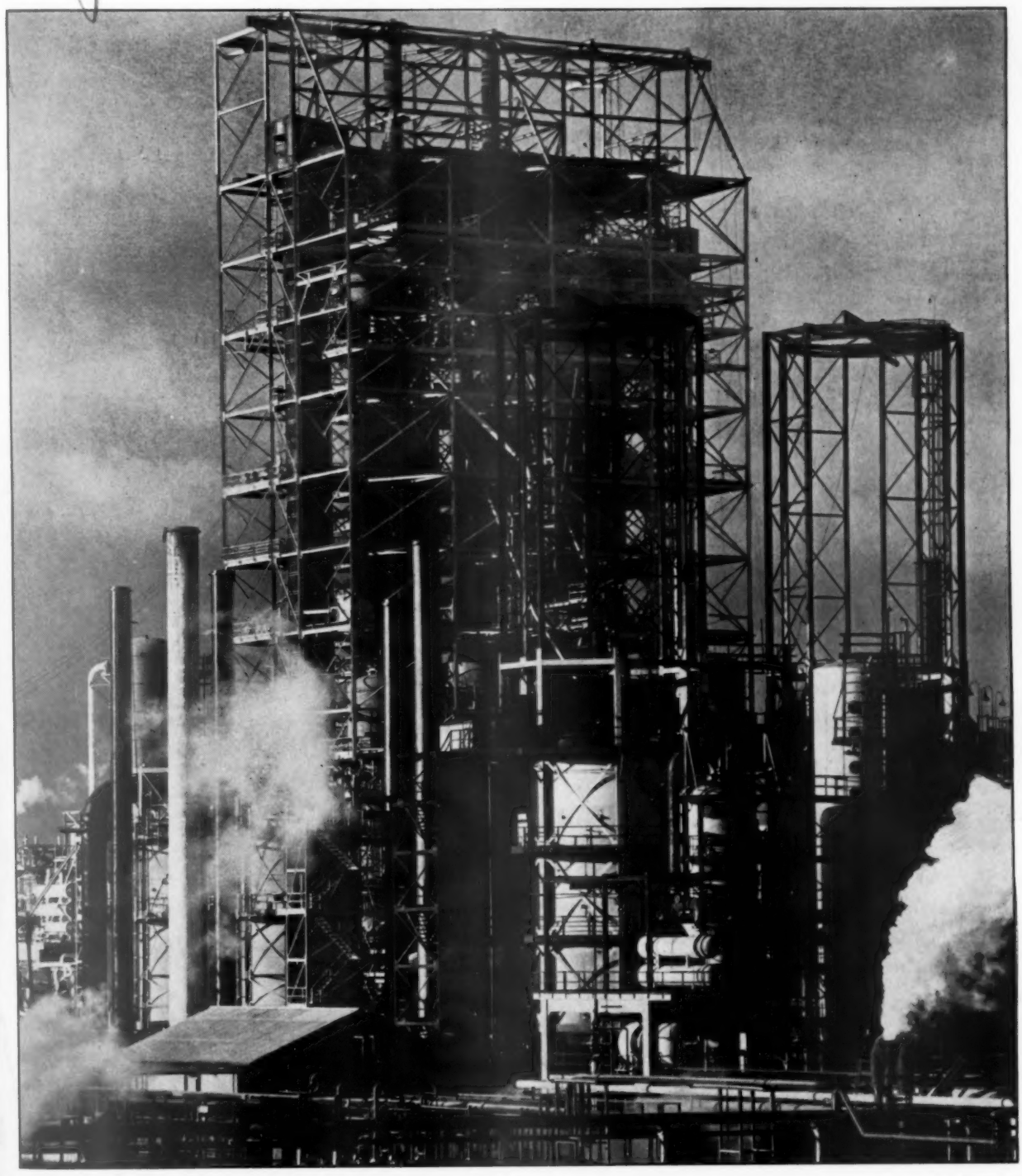
Section Two

December 6, 1944



VOLUME OUTPUT OF AVIATION BASE STOCK—At the modernized refinery of Richfield Oil Corp. at Watson, Cal., topping, thermal cracking and catalytic cracking units are operated to produce the maximum base stock for 100-octane gasoline from a crude throughput of 70,000 bbls. daily. In the foreground are two of six de Florez cracking heaters, which run a heavy gas oil from the topping unit into cracked distillate. The de Florez units are 138 ft. high, the steel superstructures over the vertical furnaces being for the removal for cleaning of the 45-ft. long alloy tubes.

The 240-ft. high structure in the background houses two TCC catalytic cracking units, which are served by a single catalyst regeneration unit. One TCC unit cracks virgin gas oil and the second recracks the partially depentanized gasoline from the first operation. Engineering on the newer additions was by the Lummus Co.

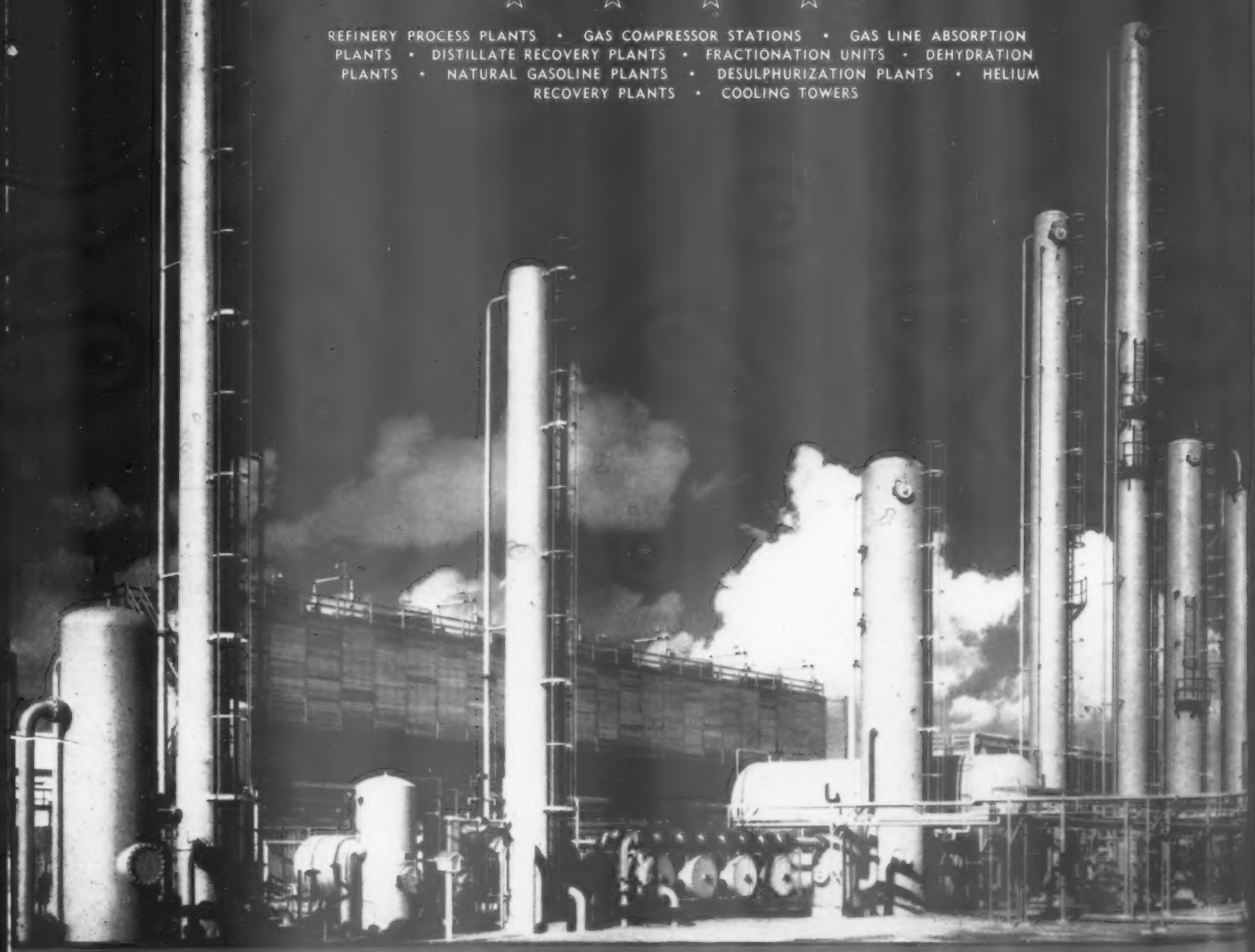
HEAVY PRODUCTION OF
LIGHT HYDROCARBONS

The experience of our personnel spans the time from the days when efficiency of recovery of liquid hydrocarbons from gas was measured only in terms of charcoal adsorption, to these days when the refining, the synthetic rubber, and the chemical industries are looking to the gasoline plant and cycling plant owner for pure liquid ethane, propane, butanes, pentanes and hexanes.

Hudson designed and constructed the first cycling plant to recover on test runs over 80% of the butanes in the raw gas feed, and other Hudson designed and built plants are in successful operation, recovering high percentages of ethanes and propanes, and closely fractionating the recovered liquid into pure hydrocarbons.

☆ ☆ ☆ ☆

REFINERY PROCESS PLANTS • GAS COMPRESSOR STATIONS • GAS LINE ABSORPTION PLANTS • DISTILLATE RECOVERY PLANTS • FRACTIONATION UNITS • DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • DESULPHURIZATION PLANTS • HELIUM RECOVERY PLANTS • COOLING TOWERS



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PRE-VUE

Of January Features

Mid-Continent Refiner Modernizes Lube Plant

Profiting from the opportunity offered by a fire in his lube plant to modernize the installation, an Oklahoma refiner has combined salvageable parts of the old plant with new equipment in installing a Duo-Sol solvent refining plant, doubling former lubricant capacity. The article describes the new unit in detail, particularly since it embodies the latest design in Duo-Sol solvent refining, and gives typical inspection data of product secured from operations to produce specification high viscosity index bright stock for military use. Flow sheets of Duo-Sol and dewaxing units are included.

Design and Fabrication of Heat Transfer Equipment

The various types of multitubular heat exchangers and the details of their assembly and fabrication are discussed by an engineer experienced in the specification and use of this equipment. Reference is made to the various construction codes and rules which govern the mechanical design and proportion of the various elements. Some of the practical considerations which determine the selection of tube diameter, tube length, baffle arrangement and general design for a given application are discussed and illustrated.

Life Testing of Lubricants

The earliest specifications for automotive engine oils covered only type of crude from which they were made and a viscosity range. Now it is possible to predict the performance of an oil by a combination of laboratory tests, identification tests and engine tests under controlled conditions. The history of the development of tests which would indicate actual service characteristics of engine oils is told by one of the leading technical authorities in the automotive field.

THIS ISSUE
SEMI-ANNUAL INDEX
of Refining Technology articles—July-December, 1944
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Newly Elected President of National Lubricating Grease Institute

B. C. Voshell . . .

PICTURED above is B. C. Voshell, manager of the technical department of Socony-Vacuum Oil Co., Inc., New York, who was elected to the presidency of the National Lubricating Grease Institute during the annual meeting in Chicago Oct. 23-25.

Mr. Voshell graduated from Harvard in 1911 with a B.A. degree. His first job was with the Metropolitan Life Insurance Co. Five years later he entered the oil business, managing the Boston office of the old Vacuum Oil Co. Later he was transferred to New York, becoming assistant manager of the technical department in 1922. In 1930 Mr. Voshell was promoted to the managership, and he retained that position after the merger of Vacuum Oil Co. with Standard Oil Co. of New York.

At last year's N.L.G.I. convention, he was elected vice-president.

(See page R-878 of this issue for review of the papers presented at this year's meeting of N.L.G.I.)

REFINERY MANAGEMENT *and* PETROLEUM CHEMICAL TECHNOLOGY

Dec. 6, 1944
Volume 36
Number 49

A MONTHLY TECHNICAL SECTION OF NATIONAL PETROLEUM NEWS *incorporating International Petroleum Technology*

IMPROVEMENTS IN TCC PROCESS

Regenerator Kiln Is Redesigned to Provide for Greater Reactivation of Synthetic Bead-Type Catalyst Now Used; Further Changes Also Incorporated in Solid Bed Reactor to Make Operation More Automatic.

By William F. Bland
NPN Staff Writer

A COMPLETELY new solid-bed regenerator kiln, permitting more complete catalyst reactivation, is the latest improvement in the Thermofor Catalytic Cracking system. It has been incorporated for the first time in the new 11,000 b/d TCC unit recently erected by Socony-Vacuum Oil Co. Inc. at its Paulsboro, N. J., refinery.

Two primary advantages are claimed for the newly developed kiln. First, it eliminates the complicated distributing and collecting tubes and angles which were necessary in the previous type of kiln for passing the regenerating air through the catalyst. Second, it permits more complete regeneration of the catalyst by increasing the period during which the catalyst is in the kiln and by providing a greater contact distance through which the air must travel.

The new TCC unit at Paulsboro, including the redesigned kiln, went on stream Aug. 25 to produce 100-octane aviation gasoline base stock. It is being used at the present time entirely for treating first pass gasoline, which is obtained from Houdry fixed-bed cracking units at the refinery.

Uses Synthetic Bead Catalyst

Catalyst used in the TCC unit is the new all-synthetic bead type, which has been developed by Socony-Vacuum during the past few years and which has the characteristic of producing fuels that have extremely high octane ratings. According to Socony-Vacuum engineers, it is possible to use the bead catalyst and produce catalytic base stocks that meet all of the requirements of 100-octane aviation gasoline without the addition of any blending agent except tetraethyl lead.

Government secrecy restrictions prevent disclosure at this time of the composition and manufacturing methods of the bead catalyst, but it is known to have high resistance to attrition, as well as greatly increased catalytic activity. The catalyst is produced in the form of small oval-shaped beads having the appearance of glass.

As part of their 100-octane program, Socony-Vacuum has also erected a plant at Paulsboro for the manufacture of the bead catalyst. It has been in operation since last April, and has already produced sufficient catalyst to equip a number of cracking units. Further details on its operation have not yet been disclosed.

Same Basic Kiln Design

The new kiln included in the Paulsboro unit is basically similar to the ones previously used in TCC units, employing a tower approximately 10 feet square, through which the catalyst flows from top to bottom, passing alternately through burning zones and cooling coils, 10 of each. The catalyst is regenerated in the burning zones by combustion in air, the excess heat generated by this burning being removed in the cooling coils. Combustion air is supplied by a conventional air blower and delivered at less than 1.0 psig to the kiln through a system of ducts, combustion products being removed through a second system of ducts. Clean catalyst is drawn from the bottom of the kiln through a system of baffles to insure uniform flow.

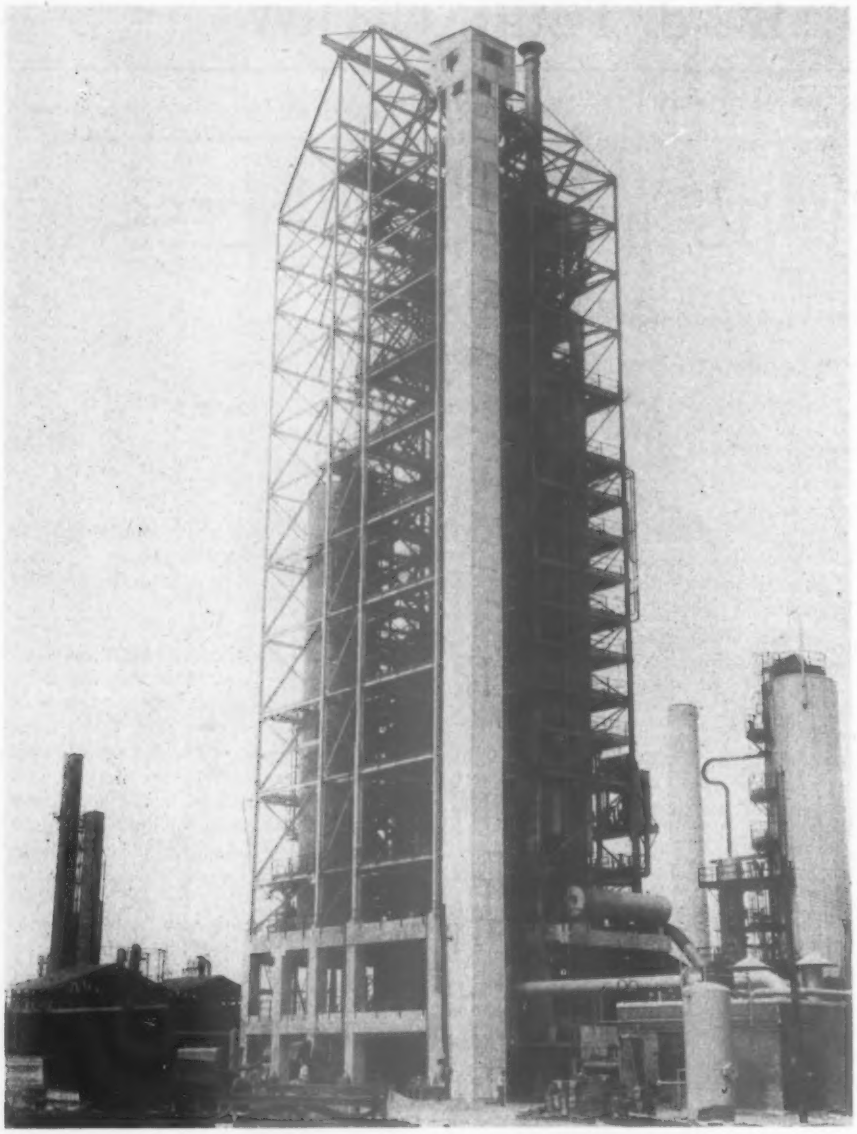
Improvements have been made, however, in the methods of distributing the regenerating air through the catalyst and of collecting the gases formed, as well as in other minor parts of the equipment.

In the old style kiln, the regenerating air passed into each burning zone through a series of vertical tubes spaced about 10 in. apart. The tubes, 1.8 in. I.D., were all manifolded at the top, air passing out of the tubes through 1 in. holes drilled through the tube walls about every 12 in. To prevent catalyst from entering the tubes and to insure even flow and distribution of the air through the catalyst, a shield was placed above each outlet hole in the tubes, the shields being inverted angular strips which extended completely across the kiln.

The gases formed by burning the carbonaceous deposit on the catalyst when it came in contact with the air were withdrawn through a similar series of vertical tubes. These outlet tubes were evenly spaced between the inlet tubes and were all closed at the bottom and manifolded at the top of the zone to a common outlet duct. They had holes through their walls and shields above the holes in the same manner as the inlet tubes.

The regenerating air entering the burning zone through the holes in the outlet tubes was dispersed throughout the catalyst as it passed out from under the shield. It flowed both upward and downward, burning off the carbon on the catalyst, which was flowing downward, the gases formed being collected under the shields on the outlet tubes and then passing out through a duct to the atmosphere, going through cyclone separators first to remove any fine particles of catalyst which may have been carried along with them.

In the new kiln installed at Paulsboro all of these complicated inlet and outlet tubes and shields are eliminated. The air is admitted and withdrawn through a simple system of channels, which are closed at the top and open at the bottom, with a cross sectional shape somewhat like an inverted "V". These channels are somewhat similar to the shields used above the holes in the inlet and outlet tubes of the old kiln, although the sides extend down about another 2 in. A single layer of channels, the channels being spaced about 8 in. apart (center to center) and parallel to one another, is located in the middle of each zone and serves as the inlet for the regenerating air. The incoming air passes both upward and downward, being collected at the top and bottom into similar single layers of channels, which in turn connect to the exhaust duct. Thus each zone has



New TCC unit at Socony-Vacuum's Paulsboro (N.J.) refinery. Tall shaft in foreground is personnel elevator, with the new kiln in the right section of the structure. The tower in the left section is for catalyst storage, with the reactor being barely visible just behind the elevator shaft. The furnace at the left preheats the charge stock, with overhead products being separated in the bubble tower to the right

one set of inlet channels and two sets of outlet channels.

Design Is Simplified

This new method of distributing air and collecting gases is much simpler in design and construction, consequently less expensive. Because of the simpler design it is possible to make the channels much sturdier. Short openings or louvers were stamped in the sides of the shields used in the previous style of kilns, making a 16-gauge metal the heaviest which could be used for practical fabrication purposes. These louvers aren't necessary on the new channels, permitting the use of heavier material—10 gauge, with a subsequent increase in durability.

Each zone in the new kiln (except the last one) is about 4 ft. deep. Since the fresh air is admitted at the middle and travels all the way to either the top or bottom of the zone before being collected and exhausted, it is in contact with the catalyst for a space of nearly 2 ft. This distance is about 6 times as great as the contact space which was obtained in the earlier kilns, in which inlet and outlet points on adjacent tubes were at the most about 4 in. apart. This longer contact space between air and catalyst permits better utilization of the oxygen present in the regeneration air, with the result that more complete reactivation of the catalyst should result.

As mentioned above, the first nine zones in the new kiln are each about 4 ft. deep, with the lowest or tenth zone being about twice as deep. This greater depth on the last zone is necessary to allow even longer contact time between the catalyst and regenerating air, which is desirable when regeneration of the catalyst nears completion and the air has to penetrate further into the catalyst to reach the final bits of carbon. The depths on all of the zones in the new kiln are considerably greater than that provided in earlier kilns. As a result, the residence period or total time during which the catalyst is contacted by air while passing through the entire kiln has been increased from 54 to 80 minutes, which also contributes to more complete reactivation. The longer residence time and longer burning zones have been accomplished in the same overall height as in the old style kilns.

Larger Air Ducts Provided

Another minor change in the redesigned kiln provides larger inlet and outlet ducts for supplying fresh air to the various zones and exhausting the resulting gases. This was done primarily to lower the pressure drop through the entire system. With the larger ducts now being used a pressure of 1 psig is all that is necessary to push the air through the kiln, whereas previously a pressure of from 2.0-2.5 psig was necessary. Because of this reduced pressure and the decreased velocity of the air as it passes through the ducts, it is possible to more easily obtain even distribution of the air to all of the zones.

As in the past, an air burner is provided in the inlet air system so that the air may be heated as high as 1000° F. to warm the system for starts and to provide some temperature control when operating. These burners fire oil or gas directly in the air stream, and are similar to a number that have been in successful operation for years on Houdry units.

Cooling Zones Control Temperature

Control of the temperature of the catalyst is maintained in the new kiln in the same way in which it has been maintained in previous units, by passing the catalyst through cooling sections placed in between each zone. Cooling water is circulated through the cooling coils by forced circulation, and ordinarily 450 lb. steam is generated in the coils. For every 5 parts of water circulated, one part of steam is generated. This assures plenty of liquid cooling medium and minimizes salt deposition in the cooling tubes.

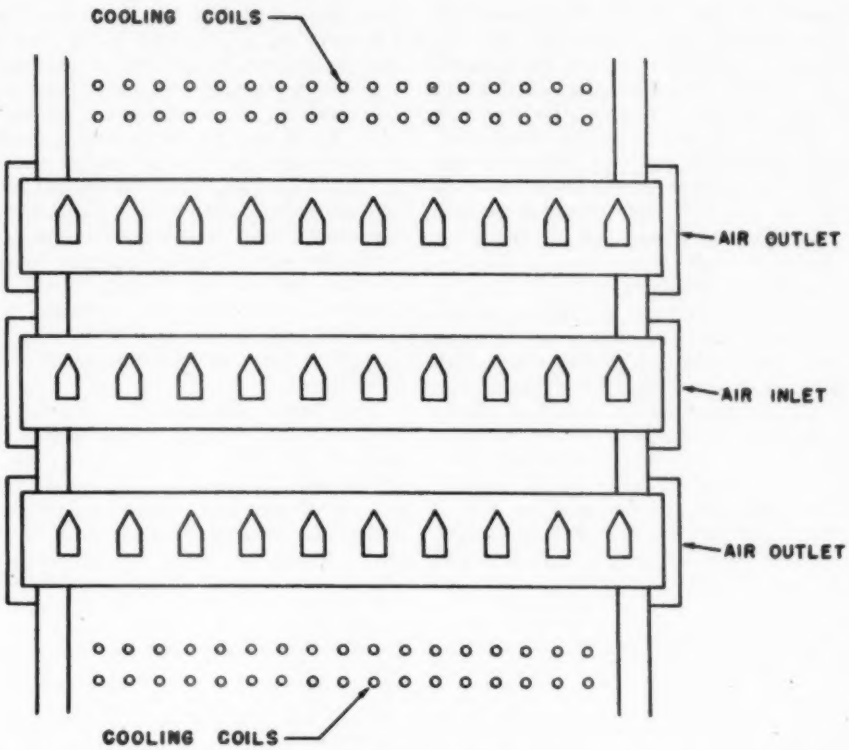
Water and steam are separated in a conventional steam drum and the water returned to the cooling coils. Treated boiler feed water is supplied to the steam drum by ordinary boiler feed water pumps. In effect, the temperature control of the system is simply a forced circulation water cooled boiler. Changes in heat load caused by varying process

conditions can be taken care of by cutting cooling coils in or out while the unit is operating.

The only change which has been made in the cooling section of the kiln has been in the design of the cooling coils. On the old kiln, 1.9 in. O.D. fin tubes, with an 0.8 in. fin at 1 in. pitch, were used. On the new kiln, the fin has been eliminated entirely, with a 2⅜ in. O.D. plain tube being used instead. Even though it has been necessary to increase the number of tubes approximately 25% in order to maintain the required cooling capacity (occasioned partially by the additional heat released in the more complete regeneration operations), these new tubes are less expensive and have the additional advantage of being easier to replace.

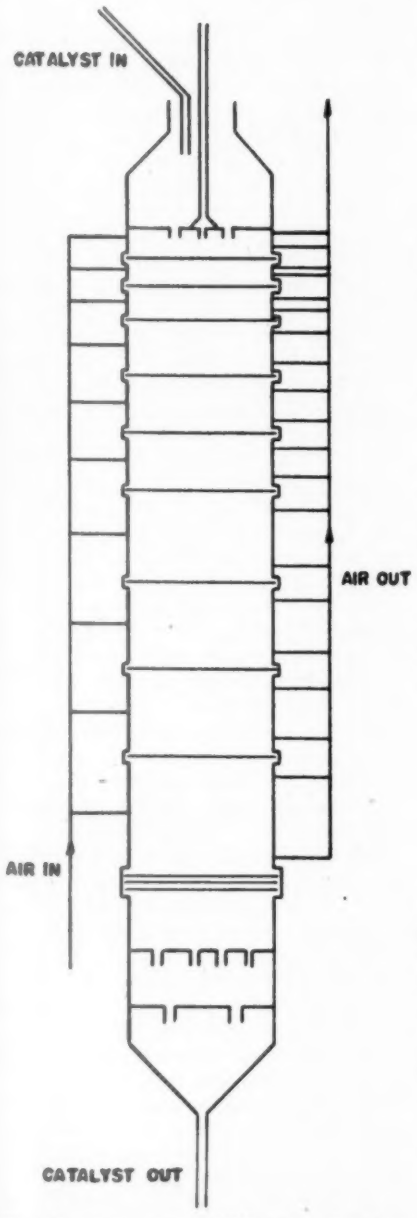
This change in the cooling coils should eliminate another trouble which has been experienced with the fin-type cooling tubes. In the past it has been found that the catalyst pellets had a tendency to form a bridge between adjacent fins, becoming jammed in tightly, and thus reducing the cooling capacity of the system. With the fins being eliminated there is no danger of this jamming occurring.

Besides incorporating the improved kiln, the Paulsboro unit also includes some minor changes in the solid bed reactor, the operation of which has been improved and made even more automatic. Up to the present time, control of the catalyst level in the hopper above the reactor was entirely manual. In the very first designs, no provisions were made to prevent the catalyst level in this hopper from rising too high and, if the operator failed to keep a close



Detail drawing of one zone in the improved TCC kiln. The air inlet duct extends across the kiln, with the distributor channels extending from the duct to the walls. Similar ducts above and below the inlet are used for collecting the flue gases. Cooling coils at the exit of each zone keep the catalyst temperature below 1150° F. to prevent rapid deterioration of the catalyst

(Note: The two drawings shown on this page were obtained from the paper "The TCC Catalytic Cracking Process for Motor Gasoline Production," by R. H. Newton, Houdry Process Corp., and G. S. Dunham and T. P. Simpson, Socony-Vacuum Oil Co., Inc., presented at the 37th meeting, Amer. Inst. of Chem. Engrs., St. Louis, Nov. 19-21, 1944.)



Sketch of a recent TCC kiln, showing the use of one fresh air inlet and two flue gas outlets for each zone

TABLE 1—Thermofor Catalytic Cracking Units In the United States and Their Capacities in B/D

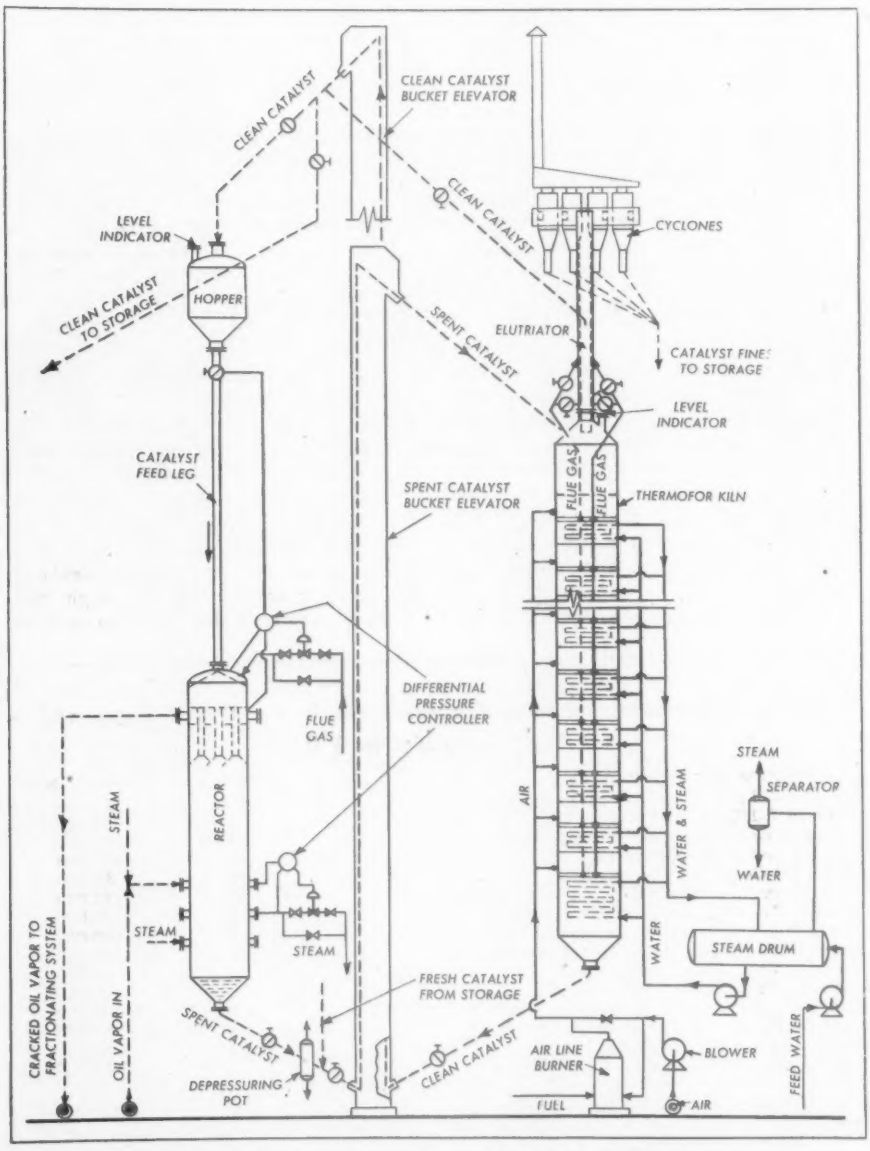
Company and location	Reactors	Capacity (b/d)
Standard Oil of California, Richmond, Calif.	*2	28,000
Richfield Oil Corp., Wilmington, Calif.	4	30,000
Socony-Vacuum Oil Co., Paulsboro, N. J.	1	11,000
Sun Oil Co., Marcus Hook, Pa.	*2	22,000
Union Oil Corp., Wilmington, Calif.	*4	30,000
Tide Water Associated Oil Co., Bayonne, N. J.	*1	11,000
General Petroleum Corp., Torrance, Calif.	4	44,000
Magnolia Petroleum Corp., Beaumont, Texas	2	20,000
Socony-Vacuum Oil Co., East St. Louis, Ill.	1	10,000
Gulf Oil Corp., Port Arthur, Texas	3	27,000
Pure Oil Co., Smith's Bluffs, Texas	2	20,000
Crown Central Petroleum, Houston, Texas	2	20,000
Ashland Oil & Refining, Ashland, Ky.	2	20,000
Sinclair Refining Co., Houston, Texas	1	10,000
Continental Oil Co., Ponca City, Okla.	3	30,000
TOTAL	34	333,000

*Not yet completed.

watch on the catalyst level indicator, the catalyst would back up into the elevator, causing it to become jammed. An overflow line was then added to the hopper, so that whenever the level rose beyond a certain point the excess catalyst would run out and into a storage bin. The control of the proper level in the hopper, however, remained manual.

On the Paulsboro unit the level indicator is utilized to activate, through pneumatic transmission, the valve at the catalyst outlet at the bottom of the reactor. Now, whenever the catalyst level in the hopper should rise or fall outside of the proper level range, this valve is automatically opened or closed sufficiently to compensate for these variations and maintain a relatively constant level. No damage could occur if the level were to rise too far, for in that event the overflow line to storage would handle the excess before it had an opportunity to back up and jam the elevator. But if the level were to fall too low, as it might in the event that something happened to interrupt the flow of regenerated catalyst from the kiln back to the reactor, the pressure seal at the top of the reactor, which requires sufficient head of catalyst above it, might be lost, with the result that the oil vapors would be exhausted to the atmosphere. A differential pressure controller automatically closes a valve in the catalyst leg if this condition should occur. These two automatic devices fully protect the unit from exhausting oil to the atmosphere at either top or bottom.

This latest installation at Paulsboro represents the second major improvement of the TCC system. The original design was characterized by what was known as the angle type reactor, in which the reactor chamber was filled with an internal baffle system consisting of angular strips of perforated metal, arranged so as to produce efficient contact between the oil vapors and catalyst. This baffle system was necessary because at the time the first TCC unit was designed it was planned to use a granular natural clay catalyst, and some means had to be provided to contact the oil vapor with the catalyst without producing excessive pressure drop through the reactor.



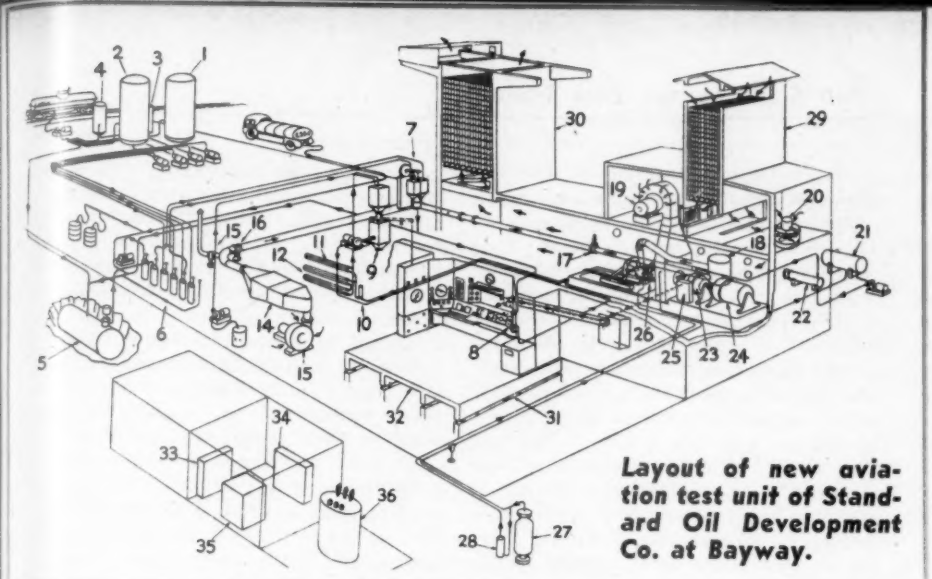
Simplified flow diagram of the Thermofor Catalytic Cracking system

Catalyst Is Improved

Subsequent catalyst developments, particularly of the synthetic bead type, eliminated the need for these distributing angles. The newer catalysts were of large enough size to allow the desired vapor flow at reasonable pressure drops. The next logical step in the development of the TCC unit, then, was to design it so that a solid bed reactor could be employed.

The solid bed reactor represented the first major improvement and is characterized by the installations which have been made at General Petroleum Corp. at Torrance, Calif. All of the four TCC units erected there include the solid bed reactor. The first was put into operation last February, and is used for cracking a gas oil charge. That was followed a few weeks later by a second unit for treating the products from the first cracking step. Both of these units employed the clay pellet type of catalyst. In May a third unit was put on stream, this one employing the new synthetic bead catalyst and being used for treating. A month later the fourth and final installation was completed, another treating unit using the bead catalyst. At that time the second unit, which had previously been used for treating, was switched over to cracking, still using the clay pellet catalyst. At the present time TCC operations at General Petroleum Corp. include two cracking units, both using the clay pellet catalyst, and two treating units, both using the synthetic bead catalyst.

Operations of these units over the past six months have afforded a good example of the increased effectiveness of the synthetic bead catalyst. When the two initial TCC units were both operating on the clay pellet catalyst (both for cracking and treating), approximately 25% of the volume of the original gas oil charge was available as finished aviation gasoline base stock. Since the treating units were changed to the use of the bead catalyst, 35% of the original charge is now converted to base stock. A corresponding increase in the octane rating has also been noted. When both cracking and treating over clay, the octane number of the leaded base stock (4.6 cc. tetraethyl lead) was 95.5 (AFD-1C), but this jumped to 98 when beads were used for the treating step. If bead catalyst were used in both the cracking and treating cases it is expected that the yields would be even greater.



Layout of new aviation test unit of Standard Oil Development Co. at Bayway.

LEGEND

1 Standard Fuels Storage
2 Standard Fuels Storage
3 Standard Fuels Storage
4 Standard Fuels Storage
5 Slop Fuel Tank
6 Fuel Filters
7 Fuel Weigh Tanks
8 Rotameters
9 Lubricating Oil Weigh Tank
10 Lubricating Oil Filter
11 Lubricating Oil Heater
12 Lubricating Oil Cooler
13 Carburetor Air Blower
14 Carb. Air Cooler, Htr. & Filt. Unit.
15 Carburetor Air Relief
16 Carburetor Air Control Valve
17 Carburetor Air Flow Meter
18 Carburetor Air Surge Drum
19 Cooling Air Fan
20 Purging Air Fan
21 Dynamometer Cooling Water Tank
22 Dynamometer Water Cooler
23 Absorption Dynamometer
24 Driving Dynamometer
25 Dynamometer Scales
26 Engine
27 Inert Gas Storage—High Pressure
28 Inert Gas Storage—Low Pressure
29 Intake Stack
30 Exhaust Stack
31 Cork Blocks
32 Floating Floor
33 Dynamometer Electronic Cont. Cab
34 440 Volt Motor Control Switchgear
35 2300 Volt Motor Control Switchgear
36 Main Power Transformer

Full-Scale Engine Test Stand For Aviation Fuel Research

Many Improvements in Laboratory Design and Testing Facilities Installed in New Multicylinder Test Stand of Standard Oil Development Co.

WHAT IS BELIEVED to be the first full-scale engine testing stand in the petroleum industry world-wide, providing for testing fuels in multicylinder engines, was opened Sept. 14 by Standard Oil Development Co. at the Bayway refinery of Standard of New Jersey.

The facilities, which cost around $500,000 to build and will take $100,000 a year to operate, were designed after inspection of a number of existing test stands operated by engine manufacturers and government agencies in this country and Canada.

The new test stand, with its special accessory facilities, is to be used as a research laboratory for quick and accurate studies of aviation fuel problems such as:

1. The testing in actual engines of exploratory fuel blends to evaluate existing processes for making high octane aviation gasoline components, and more particularly new processes, thus enabling decisions as to their desirability for commercial production. It will also permit the evaluation on a relative basis of the components now available for the blending of aviation gasoline.

It is important that multicylinder investigations be carried out so that the necessary decisions on manufacturing can be made well in advance of the day when volume production is needed.

2. Influence of engine operating variables on fuel performance and anti-knock behavior, e.g., effect of speed, spark advance, mixture ratio and automatic ratio control, temperature, compression ratio, and pressure as influenced by supercharger (blower) gear ratio, etc.

3. Anti-knock requirements of engines operating under combinations of the above variables, and particularly those combinations found to exist in practice. Present knowledge on this score is inadequate.

4. Fuel-to-cylinder distribution pattern of engines operating under combinations of above variables, when using fuels of different volatility characteristics.

5. Closely allied with the preceding study would be the influence of distribution on the behavior of fuels having their anti-knock quality controlled within the distillation range and thereby permitting setting a specification to insure optimum performance over a wide range of conditions.

The main structure of the new aviation test stand includes the test cell with its intake and exhaust stacks, control room, equipment room, service room and, on mezzanine floors, two fan rooms, an air filter chamber, and a weigh scale room. The test cell, stacks and fan rooms are of heavy reinforced concrete construction with walls from 12 in. to 16 in. thick. Other portions of the structure are built with brick walls, wood rafters, and gypsum roofing. The test cell itself is 77 ft. long by 18 ft. wide with a clear height of 20 ft.

Due to the extremely high level of sound intensity which will obtain in the test cell (about 135 decibels), careful attention has been given to minimizing the transmission of sound to the control room and the surrounding area outside the stand. The primary step taken was to line the 16-in. thick concrete walls of the test cell with a 4-in. layer of sound absorbing tile. One end and the side walls for about 60% of their length are so treated. The remaining walls enclosing the downstream end of the cell are not lined with acoustical tile, as these walls will get very dirty in service and the relatively soft rough surface of the tile would not only be extremely difficult to clean but would also increase fire hazard.

Doors and windows are usually the greatest source of leakage through so-called soundproof walls. There are no doors leading directly from the test cell to the control room but there are 3 observation windows, one of which, located in the center of the main operating panel, is 6 ft. long by 2 ft. high. All three of these windows are built with four panes of special glass employing desiccants to dry the space between the panes to avoid clouding from condensation of moisture. Four different thicknesses of glass varying from ¼ in. to ⅝ in. are used to minimize sound transmission by avoiding sympathetic vibration or drumming of the panes.

On the control room side, the first pane of glass is of the laminated shatterproof type. The glass used for the other three panes in each window is of special type with high strength which when fractured does not shatter to form sharp splinters but rather disintegrates into small pieces and beads without sharp corners. Each doorway to the test cell is provided with two metal-clad soundproof doors. Indicator lights on the main control board show whether they are open or closed.

Both the inlet and the outlet stack have been packed with sound absorbing artificial stone, having the appearance of a fine grained cinder concrete, moulded into large hollow blocks which when laid in place leave about half of the stack area as free air space. Sound waves while finding their way out through the stacks

are reflected from the rough surfaces so many times that much of their energy is lost. A reduction of 25 decibels is expected in the sound level outside the stacks as compared to the conditions inside the test cell.

In order to reduce or damp the vibrations from the engine, the entire rotating assembly, consisting of the test engine, stub shaft and dynamometer, is mounted on a massive block of concrete weighing 240 tons which is in turn doweled directly to the pile cap forming the foundation for the whole building. The instruments in the control room have been isolated from the rest of the structure by building the control room floor as a separate unit, free from the walls on all sides, supported on blocks of cork designed to absorb the remaining vibration which would otherwise be transmitted through the foundation.

The control room is furnished with a ventilating system which provides a constant supply of fresh filtered air, heated when necessary, under a slight pressure. The pressure is maintained so that it is just above that existing in the test cell to eliminate the possibilities of exhaust gases from the cell leaking into the control room.

A service room 34 ft. x 23 ft. has been provided next to the outlet end of the test cell. It provides space for preparing engines for test, making minor repairs, tool storage, etc. Monorails, chain hoists, and portable engine mounts are available to handle engines between the service room and the test cell.

Equipment

A laboratory for studying the performance of fuels in internal combustion engines must be equipped with facilities for loading the test engine, together with means for controlling, measuring, and dissipating the power developed as well as facilities for supplying, controlling and measuring fuel, lubricating oil, combustion air, and cooling medium; and to provide the necessary fire protection and safety features. When fuels are to be tested in modern multicylinder aircraft engines, the equipment requirements enter a range of sizes far in excess of those normally considered in the laboratory class. In the test stand, 100 hp is needed just to supply combustion air to the engine carburetor, 400 hp is consumed in furnishing cooling air and a total of some 1100 hp in electric motors is required for operation of the test stand.

Engine Mounting

The test stand is designed to handle either liquid or air cooled engines and to test pusher as well as tractor power plants. The engine to be used in the tests is rigidly mounted close to the cooling air duct on a tubular steel ring mount simulating the mount provided on a plane. The ring mount is supported by a heavy cast steel stand secured by tee bolts to a massive cast iron bed plate.

The horsepower output of the test engine is absorbed and measured by an eddy current absorption dynamometer. This dynamometer consists of an inner member rotating in a strong magnetic field, and an outer member which tries to rotate but is restrained by linkages connected to a weighing scale which indicates the turning effort (torque) developed by the engine. The torque indicated is used to calculate the useful or output horsepower of the engine. This net horsepower is the power that would be delivered to the propeller of the plane and does not represent the total power developed since power is lost in overcoming the friction of the engine and a large amount of power is required to drive various engine auxiliaries, such as the supercharger.

In order to measure the power lost (commonly referred to as friction horsepower), a driving dynamometer comprised of a squirrel cage induction motor and a variable speed magnetic coupling is employed to drive the test engine at the same speed and under the same conditions as when the useful horsepower is being measured, except that, of course, the engine ignition is turned off. The value of horsepower determined in this manner is then added to the output or useful horsepower to obtain the total power developed by the fuel. The driving dynamometer can be operated as an auxiliary absorption unit by locking the induction motor half of the magnetic coupling to the frame of the driving dynamometer and energizing the coupling's field windings.

The absorption unit will absorb 2000 hp over a 1200 to 2500 rpm speed range. The driving dynamometer has a driving capacity of 500 hp at 1750 rpm, and has a speed range of 0 to 1750 rpm. By using the magnetic coupling of the driving unit as an auxiliary absorption dynamometer 2500 horsepower may be absorbed over the 1200-2500 rpm speed range.

To dissipate the heat developed by the absorption dynamometer a closed cooling water system, consisting of the dynamometer water jackets, circulating pump, heat exchanger, or cooler (22) (See Fig. 1) and sump (21) is used. Since the capacity of the dynamometer is limited by its ability to dissipate the generated heat, periodic tests and treatments are made to control water conditions, thus minimizing scale and corrosion, the major causes of poor heat transfer.

In order to meet the exacting standards of research work the dynamometer is electronically controlled. With this type of control, speed is held very closely from no load to full load, and it permits rapid transfers from absorption to driving with no change in speed. This feature is quite important for accurate test results; since as soon as the ignition is cut for a driving test, the engine begins to cool. Therefore measurements must be made before temperature changes have a chance to affect engine friction.

Control of the test engine, dynamometer, and all auxiliary equipment is centralized at the instrument panel in the control room. To minimize the human element, all controls are extensively interlocked to prevent inadvertently breaking continuity of test runs, and to safeguard personnel and equipment.

Remote indication of the dynamometer scale reading is obtained by means of an optical system. A projector unit at the scale (25) projects an image of the scale dial. The beam of light in its 20 ft. of travel goes through 4 layers of window glass to enter the control room, then makes two 90° turns by means of mirrors, and finally ends up on a ground glass viewing screen on the instrument panel.

Cooling Air

The engine cooling air is drawn in through the intake stack (29), passes through a group of heaters, through an inlet damper and into the cooling air fan (19). The fan discharges into the cooling air duct where the air passes through another set of dampers, makes a 90° turn and is directed over the engine by an adjustable cowling. The cooling air then mixes with engine exhaust gases and purging air in the test cell and is finally discharged to atmosphere via the exhaust stack (30). The cooling air fan, driven by a 400 hp electric motor, has a capacity of 50,000 cfm at a differential static pressure of 27.7 in. of water gauge, with air at 100°F. The inlet heaters are capable of heating 50,000 cfm of air from 0 to 100°F., thus permitting standardization of cooling air temperature at 100°F. winter and summer.

Purging Air

To prevent the accumulation of exhaust gases in the upstream end of the test cell and to help keep the test cell from getting too hot, a purging air fan (20) takes air from the intake stack and discharges into the upstream area of the cell. This fan, driven by a 30-hp electric motor, delivers 50,000 cfm at 2.0 in. of water, gauge. Air flow through this blower is not controlled except to the extent that an inlet damper is provided and interlocked with the emergency stop button to trip it closed in case of fire in the test cell.

Carburetor Air System

Air is supplied to the engine for combustion by a two-stage centrifugal blower (13) which will deliver 4000 cfm at a differential pressure of 3 psi when handling air from the atmosphere at 90°F. This blower is driven by a 100-hp motor. The air, after leaving the blower, passes through a set of face and bypass dampers over heating or cooling coils (14), through filters, into a 16-in. duct, in which are orifice flanges for check test orifice plates, and an adjustable orifice (17), into a surge drum (18) and then into the carburetor. All of this equip-

ment following the filters is made of rust-proof material. It is essential that both the volume and temperature of the carburetor air be controlled within very close limits and accurately measured.

The volume of air is determined by the differential pressure across an adjustable orifice, as indicated by an inclinometer having a range of 0-6 in. of water. The inclinometer is adjustable to correct for air temperature and barometric pressure so that it can be read directly in pounds per hour. To secure accurate measurements of air over a very wide range (0-24,000 lbs. per hr.) the orifice is of the segmental type with a gate which can be moved to any one of 6 positions by means of an air operated cylinder mounted on top of the gate and positioned remotely from the panelboard. A change in position can be made in less than 10 seconds. A set of 6 concentric orifice plates has also been provided for installation upstream of the adjustable orifice for check purposes. Straightening vanes and 40 ft. of straight pipe ahead of the main orifice meter assure good flow characteristics for accurate measurement.

The temperature of the carburetor air is controlled within half a degree F. by means of an electronic potentiometer recording controller which positions the face and bypass dampers changing the amount of air passing over the heating and cooling coils.

The pressure is controlled within .2 in. of water by means of a differential pressure controller with a range from 44 to 64 in. of water above atmosphere. Normal operation will be 54.4 in. of water above atmosphere. This instrument operates a butterfly valve (16) in the air line ahead of the straightening vanes.

Fuel System

The fuel system includes facilities for unloading railroad tank cars, tank trucks, and drums. The special test fuels will normally be pumped direct from tank trucks or drums. Whenever the fuel being used in the engine is changed, all lines and measuring equipment must be drained to prevent contamination. This fuel drains to an underground sump tank (5) of 2000 gal. capacity. The mixture of various fuels contained in the sump or slop fuel tank may be used to start and warm up the engine.

The fuel system presents two distinct problems in control. First the fuel must be pumped from the desired source to the selected weigh tank, and the operator in the control room must have positive indication of the source and the path of the fuel being pumped. Once the desired fuel has been delivered to the selected weigh tank, the problem then becomes one of controlling and measuring the flow of fuel to the test engine.

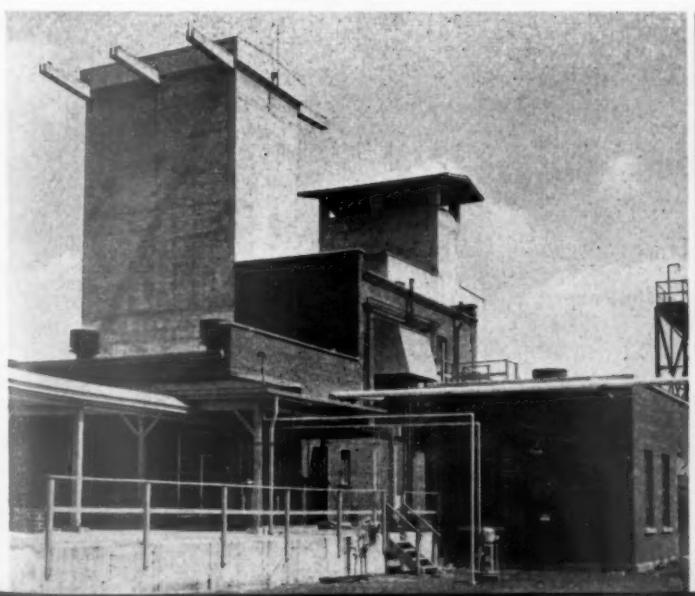
Each of the 4 aboveground storage tanks, the underground sump tank, and the barrel unloading rack has a fuel pump which may be connected to deliver fuel to either of two weigh tanks (7). The inlet lines to the two weigh tanks run from the tanks to a point outside the service room where they terminate in lengths of flexible tubing equipped with special couplings. The discharge lines from the fuel pumps terminate in filters (6) located at this same point outside the service room. The flow of fuel is arranged by connecting the flexible tubing on the end of the desired weigh tank inlet line to the discharge line of the pump handling the selected fuel. The electrical circuits controlling the fuel pump motors have been designed and interlocked to prevent inadvertently making the wrong piping connections, and to provide remote indication on the control room instrument panel of the specific fuel being pumped to each weigh tank.

The fuel weigh scales used in this installation are located on the mezzanine floor and are not normally under direct observation when a measurement is being made. When no measurement is being made, a liquid level controller keeps the tank full by means of a valve in the gasoline inlet line. The dial of the scale is fitted with several sets of photo cells and light sources. The cells are located at points around the circumference of the dial corresponding to fuel weights of 6-2/3, 13-1/3, 26-2/3, and 53-1/3 lbs. (roughly corresponding to 1, 2, 4 and 8 gals.) A selector switch on the instrument panel is used to select the desired weight of test fuel to be used. To operate the fuel weigh scales, a test button is pressed. This closes the control valve shutting off the gasoline supply to the tanks and the weight of fuel in the tank will decrease.

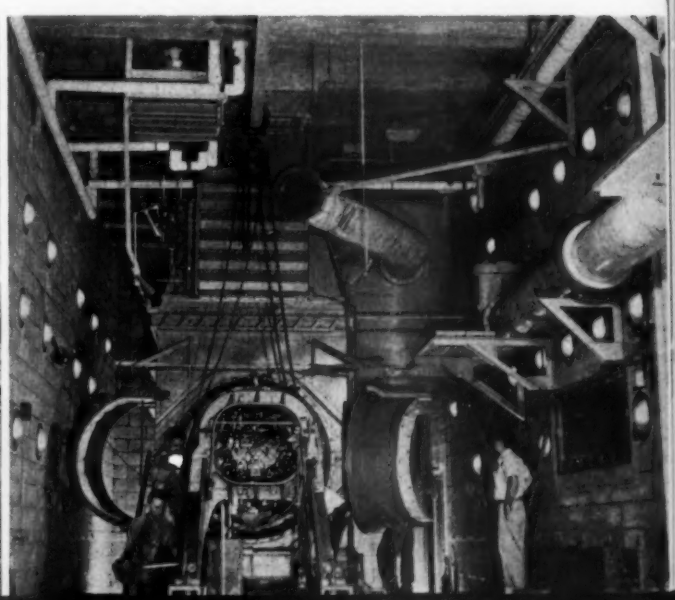
A timer on the instrument panel is started when the scale pointer passes between the "start" photocell and its light source. A short period is allowed between the normal full position of the tank and start position of weighing to allow all fuel to cease dribbling off of the fuel inlet pipe. When the scale pointer interrupts the light to the photocell corresponding to the selected weight increment the timer stops, and the liquid level controller again fills the tank, thus the time required to consume a fixed amount of fuel is measured. The timer dial is calibrated to read directly in pounds per hour.

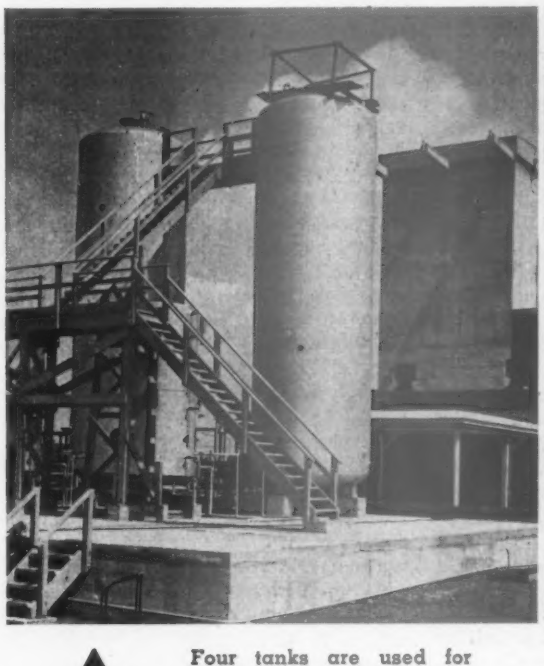
The weigh scale is fitted with two weigh tanks to permit switching fuels without interrupting test procedure or otherwise interfering with engine operation. Fuel is supplied to the engine pump by gravity. The outlet lines from the weigh tanks are tied into a common line through a two way selector valve in the control room. From the valve the fuel goes to a set of rotameters (8) which give a visual indication of rate of fuel consumption at all times. Rotameters

Exterior view from the rear of the new aviation fuel testing laboratory. The unit, built for a cost of around $500,000, will take $100,000 a year to operate



General view of the interior of the fuel testing unit cell. Observation window of the control room is at the right.





Four tanks are used for storing special test fuels which will be used in the new laboratory

Each storage tank is equipped with its own pump and individual pipeline to carry testing fuels to the engine and prevent contamination with other test fuels

differ from conventional flowmeters using a fixed orifice as, in the rotameter, the pressure drop is constant and the size of the orifice varies.

Each rotameter consists of a glass tube uniformly tapered from bottom to top, in which is placed a float of specially selected material designed to minimize the effects of variation in fuel density and viscosity as far as possible, i.e., with a fuel of .720 specific gravity as standard a gravity change to .675 will have a correction factor of .998. The same correction factor applies for a fuel with a gravity of .765. The float is guided in the tube by a wire under tension which passes through the center of the float and is fastened at either end of the tube in such a manner as to be in the exact center.

As flow increases through the tube, the float rides higher to give the necessary increase in orifice area and the flow is determined by observing the position of the float. The set consists of 3 rotameter tubes having ranges of 20 to 100, 100 to 500, and 500 to 3000 lbs. per hour, respectively. The flow is through the 3 tubes in series up to rates of 500 lbs. per hour. Above 500 pounds a tight shut-off valve is opened, bypassing the smaller tubes in order to keep the total pressure drop below 3 in. of mercury.

From the rotameters the fuel enters the test cell and flows directly to the engine fuel inlet connection.

As the primary purpose of the test stand is to determine variations in the performance characteristics of different aviation fuels and since these variations may be small, no contamination can be tolerated. Separate lines, fuel filters, and the slop fuel drainage system go far towards achieving this objective, but in addition all piping, valves, weigh tanks, etc. following the fuel filters have been made of KA2S alloy steel to eliminate corrosion and the consequent introduction of foreign matter into the fuel.

Lube Oil System

Lubricating oil is delivered to the laboratory in barrels. A pump transfers the oil to a reservoir located directly over the oil weigh tank (9). Another pump is provided to circulate oil through the engine and heating oil (11) until both the oil and engine are warmed up. Once this condition is reached the pump is bypassed and the oil is circulated by the engine pump. Normally the oil flows from the reservoir to the weigh tank, to the engine, through the filter (10), then through the coolers (12) and back to the reservoir. An air-operated control valve is located between the reservoir and the weigh tank.

The oil weigh scale is located on the mezzanine floor in the same room as the fuel scale and is connected by a mechanical linkage to a dial on the control room instrument panel. The scale is equipped with a pointer which continuously indicates the weight of oil in the weigh tank. An additional pointer is provided which is connected to the main pointer by a magnetic clutch when a weigh test is made, and stopped by a magnetic brake when the weigh test is finished. The clutch is controlled by a fixed interval timer.

When the operator presses the "measure" button the control valve shuts, trapping the oil in the reservoir, the timer starts and the pointer is engaged. A time delay is also provided on this weighing mechanism to allow time for all of the oil to drain off of the inlet pipes before the weighing or timing mechanism is started. When the timer reaches the end of its cycle the pointer is stopped by the magnetic brake, and the control valve opens. The pointer indicates pounds of oil circulated and since the time interval is known the rate of flow is established. When no circulating measurement is being made the oil scale may be used to determine the oil consumption over a period of time.

Temperature Instruments

Equipment is provided for indicating temperatures at 126 points. Thermocouples at all points are wired to a common terminal board, from which they are connected to a switch bank for an electronic self-balancing potentiometer type indicator so arranged that only one point can be switched to the indicator at a time.

Another temperature indicator of the millivolt meter type has been provided with an 18-point switch which will be used to give a continuous indication of the head temperature on the hottest cylinder. If it is desired to follow temperatures on more than one cylinder, the self-balancing potentiometer indicator can be set to indicate temperature continuously at another point and the 48-point recorder can be set to record on a third point.

Nine other temperature indicators of the conventional bulb and tube type are provided for various other points such as oil in and out of the engine, fuel temperature, and the like.

Numerous test temperatures must be

recorded in the shortest time possible. For this purpose, an electronic strip chart temperature recorder is used. It is equipped with a switch which produces an electrical impulse each time a temperature is recorded on the chart. The impulse is used in a telephone type switch to change the temperature point connected to the recorder. The recorder will print ½ second after the correct temperature is reached. The chart is 10 in. wide and the print carriage travels the full width in 4.5 seconds, so that if the temperatures are less than 20% of the scale range apart, one reading will be printed every second.

Normally, a set of 48 readings will be taken in about one minute. The instrument can be used to record 144 points as it was originally designed for use in 4-motored bombers. A special feature of this particular instrument is that it does not operate continuously. When a record of all points is desired, a button is pressed, the points are recorded and the instrument stops. However, by pressing another button, any one of the 48 points can be indicated continuously.

Miscellaneous Instrumentation

A special cathode ray oscillograph has been designed for this unit to provide a visual indication of detonation in the engine. This oscillograph incorporates two 5-in. cathode ray tubes so connected or interconnected that they may virtually be used as one 10-in. tube or as separate tubes. Each tube may display the detonation in half of the engine cylinders or one tube may show the total number of cylinders while the signal on the other tube has been expanded for a more detailed study of the detonation conditions in one cylinder. The oscillograph is connected through proper filters, amplifiers and control circuits to pick up units mounted on the engine cylinders which will indicate the magnitude of cylinder vibrations associated with detonation.

Seven pressure indicators are mounted on the panelboard and 16 other pressure indicators are connected at various points throughout the unit.

An exhaust gas analyzer has been provided which serves as a guide for combustion control and engine operation.

Fire Protection

Two systems of fire protection are installed at the test stand. One involves the use of an inert gas which was already available in high pressure storage close to the test stand site and the other system relies on conventional cylinders of CO_2. The latter system protects the weigh scale room, the control room, and the area in the test cell surrounding the engine and the dynamometer.

Release of CO_2 in the weigh scale room is automatic. A high rate of temperature rise such as that which would accompany any outbreak of fire in the room is utilized to trip the release mechanism, as no operators are normally stationed at that location.

For the test cell and the control room, manual pulls have been provided, located in the control room and just outside the control room exit, respectively. In the event of a fire in the control room, the occupants leave the room promptly and operate the manual pull outside the exit. Pressure switches on the CO_2 line will then shut off the engine together with all fans and dampers. When the manual pull is operated, discharging carbon dioxide on to the engine and dynamometer in the test cell, the emergency stop system on the control board is also actuated. As a result, all of the air blowers discharging into the test cell are stopped and all dampers closed so that no more fresh air will be fed to the fire or blow the CO_2 away from the area being smothered.

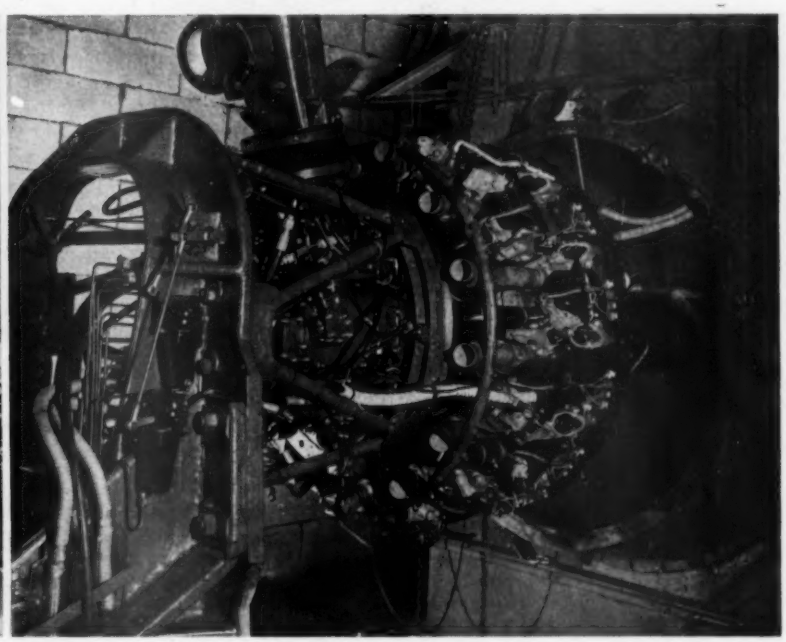
The inert gas system is specifically intended to handle engine fires. The gas is a mixture of carbon dioxide and nitrogen. It is stored in a pressure vessel at a pressure which may vary between 2000 and 3000 lbs. per sq. in.

The inert gas has been applied to another important function closely allied to actual test operations. When making tests under lean mixture conditions, there is a tendency for combustion to back up into the supercharger and to burn at the fuel nozzle. Many times it would not be immediately apparent to the operator that combustion was taking place in the supercharger. It is also undesirable to have to shut the engine off to extinguish such a fire as the operator is seeking the ultimate point at which test readings can be taken. To permit continued operation in cases of supercharger fires automatic injection of inert gas to the supercharger has been provided to extinguish the fire quickly and cool the supercharger.

Two solenoid operated valves in series are used to release the gas, and a temperature indicator is mounted in the control room to provide a check on the functioning of this equipment. A red light on the panelboard indicates when the gas is being discharged to the supercharger.

Four panes of shatter proof glass make up this observation window in the control room

This 1500 HP aircraft engine is used for testing the behavior of new fuels in modern engines under exacting conditions of higher speeds, greater compressions and hotter temperatures



New Developments in Principal Catalytic Cracking Processes Are Described

By D. P. Thornton, Jr.
NPN Technical Section Staff

LATEST DEVELOPMENTS in Fluid, Houdry and TCC catalytic cracking processes were described before the American Institute of Chemical Engineers at its 37th annual meeting in St. Louis, Nov. 19-21.

The more than 800 members and guests attending heard, in addition to the advances in refining technique, details of some of the chemical engineering efforts which have made possible the large-scale production of butadiene and styrene for synthetic rubber. Discussions of the mass spectrometer as an analytical tool also were among the papers of interest to the oil industry.

Both sides of butadiene production were told—from alcohol as a raw material and from petroleum. The paper "Production and Purification of Butadiene from Alcohol," by W. S. Brackett and J. L. Marsh, Carbide and Carbon Chemicals Corp., discussed the process developed by this company, which represents 220,000 tons annual rated capacity, and now is operating at 50% in excess of rating.

Alcohol-Butadiene

The alcohol-butadiene story was told first, although in limited detail. Essentially, the process consists of catalytically dehydrogenating a portion of the alcohol feed to acetaldehyde and then, also catalytically, reacting the acetaldehyde with an equivalent proportion of alcohol to form butadiene and water.

Actually, the reaction also produces such side products as butylenes, ethylene and ethyl ether which, in the original design, were not recovered; also, the conversion is not complete, reactor effluent containing, in addition to the products already listed, some unconverted acetaldehyde and alcohol.

To save critical items of metal and equipment, as well as money, the acetylene converter effluent is combined with that from the butadiene converter after removal of butadiene has been affected through distillation. By-products are separated by distillation and unreacted acetaldehyde and alcohol are returned to the process.

Efficiency of the process, without recovering valuable by-products, has been approximately 61.6%—improved to around 65% when load on the plant was reduced earlier this year to 150% of rating. When plans now underway for the recovery of ethylene, butylene, and ethyl ether are completed, efficiency is expected to increase to approximately 75%. Butylene will be routed to petroleum butadiene plants, or for production of alkylate; ethyl ether will be converted in revamped equipment now idle to ethyl alcohol and ethylene.

"Production of Butadiene by Dehydrogenation of Normal Butylenes," the petroleum side of the synthetic rubber picture, was discussed in a paper by R. P. Russell, E. V. Murphree and W. C. Asbury, Standard Oil Development Co. The process, in use in seven plants having a combined rated capacity in excess of 300,000 tons per year, is based on the catalytic dehydrogenation of normal butylenes to butadiene.

A new type of dehydrogenation catalyst, designated only by a number, was developed to overcome poisoning by steam, a serious shortcoming of the older catalyst. This permits steam dilution of the feed so that partial pressure of butylenes is much below atmospheric, yet it is unnecessary to operate the unit under a vacuum to attain commercially useful selectivity and conversion rates with elevated temperatures and short residence times. Difficulties in practical design are posed by several complicated factors, two of which are the involved thermodynamics of the reaction and the tendency of butadiene to polymerize and degrade to coke. Solution of much of the problem is made possible by the catalyst, diluting the reactants with steam, using steam to supply heat for the endothermic process and using high flow rates to assure short residence time. Steam also has another function, in that it also is used as the catalyst regenerative medium; it reacts with the coke, when butylene supply is cut off, to produce carbon monoxide and hydrogen without necessity for air compressor equipment or provision for purging the reactor before and after regeneration.

At the present time, the pioneer unit using this process (at Standard Oil Co. of Louisiana refinery, Baton Rouge) has produced at 139% of rating and probably will go higher. The design utilization factor of 0.61 lb of recovered butadiene per lb of butylene disappearing has been attained, with no serious operating or mechanical difficulties experienced. Plant investment for wartime conditions was given as $385.00 per ton of butadiene per year, but this figure will vary because of scale of operation from as low as $250 (peace time) to $480.00. Operating costs will range from 4.5 to 7.5c per pound (exclusive of raw materials) and postwar competitive butadiene price is estimated to range from 8-10c per lb.

The distinctive features of the Houdry process were explained to the assembled chemical engineers by R. H. Newton, Houdry Process Corp., in a paper "The Design and Operating Features of Houdry Fixed Bed Catalytic Cracking Units." Particular emphasis in this paper was on the chemical engineering required to bring the process to commercial success, although much of the story can be inferred from previous literature.

After describing fundamentals of the Houdry process, the paper brought out some of the difficulties which had to be gotten around before the method became practical. One of the greatest achievements, it was said, is the development of the molten salt heat transfer medium, a mixture of inorganic salts which melt at approximately 285°F. With this system, it is possible to control catalyst bed temperature to within a maximum of 200°F. differential of the salt temperature and at the same time to utilize waste heat from catalyst regeneration so efficiently as to supply necessary process power.

Molten Salt Under Vacuum

The molten salt, circulating through finned tubes in each reactor-case, is maintained under a high vacuum. This is necessary to avoid an explosion in the event of a leak from cooling system to the case, since the salt is a strong oxidizing agent. As the oil vapors are under a positive pressure, any leak will be of oil vapors into the salt system resulting only in a non-explosive combustion of the oil vapors. As an additional feature, the vacuum system permits removal of any oxides of nitrogen which may be liberated from the salt, and assures salt penetration to all parts of the heat-transfer system.

Waste heat, generated by catalyst regeneration with air (combustion of coke deposit on catalyst), is utilized to produce process steam by passing the molten salt coolant through waste-heat boilers, and also in heat-exchangers which preheat the feed and air for catalyst regeneration. In addition, the hot flue gases from catalyst regeneration are passed through a gas turbine which, in turn, drives a compressor supplying air at about 45 psig for regeneration. The turbine develops an excess of power at times and is then used to drive an electric generator. In many installations it has been possible to supply a small excess over all needed process steam and electric power requirements for the unit. Overall heat efficiency of the latest design of unit is reported to be 74%.

Improvements in design of Fluid units for catalytic cracking were described in a paper "Improved Fluid Process for Catalytic Cracking" presented by E. J. Gohr, Esso Laboratories, Standard Oil Development Co.; in collaboration with E. V. Murphree, Standard Oil Development Co.; C. L. Brown, Esso Laboratories, Standard Oil Co. of Louisiana; and C. E.

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Jahnig, H. A. Martin and C. W. Tyson, Esso Laboratories, Standard Oil Development Co.

The paper describes the new "downflow" unit. Main points of improvements on the well-known Fluid system comprise simplification of catalyst flow, reduction of equipment items required, easy separation of catalyst from oil, and greater flexibility in handling charge stocks which need not be pre-vaporized.

After describing the basic unit, the paper stated the original reactor had been redesigned to provide a vapor-disengaging space above the reaction zone (by sharply reducing the velocity of the turbulent "fluid"—oil vapor and catalyst). A single cyclone separator is provided, integral with the reactor, to "knock down" any intrained catalyst carried out of the disengaging space. This catalyst, plus that dropping from the vapor in the disengaging space, drops from the bottom of the reactor into a standpipe. From the standpipe it is carried by an air-stream into the regenerator, where the coke is burned from the catalyst. Flue gases from the regeneration, passing overhead, are relieved of entrained catalyst by another cyclone separator.

Hot catalyst from the regenerator is taken downward in another standpipe, from which it flows into the fresh charge stream. The amount of heat added to the charge stream can be accurately controlled to supply the necessary feed preheat, heat of feed vaporization, and the heat needed for the cracking operation, the paper states. In addition, any excess heat produced during the regeneration, above that needed in the process, is recovered by circulating the desired amount of hot catalyst through a waste-heat boiler and back to the regenerator.

Design of a unit in this manner eliminates hoppers for the necessary catalyst capacity and considerable of the standpiping required on earlier units; this makes for a more simple catalyst system and reduces friction losses. It also reduces the heating load on the refinery by making possible the heating and vaporizing of its own feed by the unit itself and supplying, in addition, some high-pressure process steam.

To give an idea of how much catalyst is circulated, the paper stated that in a 15,000 b/d plant, ratios of catalyst to oil of 5 to 30 to one often are carried, with temperatures of the order of 1000 to 1150°F. and pressures of eight to 15 psig. It takes five men to operate a 15,000 b/d unit.

Of the 36 Fluid plants now operating in the U. S., representing a combined capacity of some 400,000 bbl per stream-day, all but four are of the "downflow" type. Experience with these units indicates they are good for six to eight months before a shut-down and that, contrary to what might be expected with the finely-divided catalyst, erosion of equipment has not been a problem. Some erosion has been encountered in slide-valves and cones, but these were deliberately designed for easy replaceability. There has been virtually no erosion in lines.

Giving figures for motor fuel quality made with the Fluid method, the paper stated that plants being operated by Standard Oil Co. of New Jersey were operating once-through, acid treating instead of treating catalytically to reduce the cost of aviation base stocks. Using a synthetic catalyst and a paraffinic feed stock to make motor fuel, cracking at 965°F. (reactor temperature), a clear octane rating of 96.8 was obtained; using a naphthenic stock, 100 octane number fuel was produced.

In closing, the paper stated the Fluid principle is adaptable for other than catalytic cracking operations. The technique is valuable where close heat control is required. Also, in ore reduction, gas manufacture and coking of coal, the Fluid process should be of considerable interest.

A description of the latest design of TCC catalytic cracking was presented by R. H. Newton, Houdry Process Corp., and G. S. Dunham and T. P. Simpson, Socony Vacuum Oil Co., Inc. in a paper "The TCC Catalytic Cracking Process for Motor Gasoline Production." The problems of uniform contact of catalyst with the reacting vapors, isolation of reaction and regeneration systems, maintenance of thermal balance by addition and removal of heat, and instrumentation and control for convenient and safe operation were discussed in this paper. In view of some of these points being discussed in another article appearing in this issue (pp. R-811-814), this paper is not further reviewed here.

Mass Spectrometry Discussed

Two papers dealt with an analytical tool introduced to the oil industry in the war — mass spectrometry. The first, "Routine Analysis with the Mass Spectrometer," was by J. A. Hipple, Westinghouse Electric & Manufacturing Co., and described an instrument particularly designed for routine analyses.

In addition to the basic requirements of the instrument itself, the four problems to be solved were outlined in the paper, as follows:

(1)—The electrical circuits. These should be sufficiently stable (electronic control) to permit the operator to ignore them during an analysis, after once setting them to their proper values for the work in hand.

(2)—Flow of the gases themselves into the instrument. This flow should be linear through the throttling device with reference to the partial pressure of components in the mixture; the constancy of pumping speed and adsorption on the walls are complicating factors here.

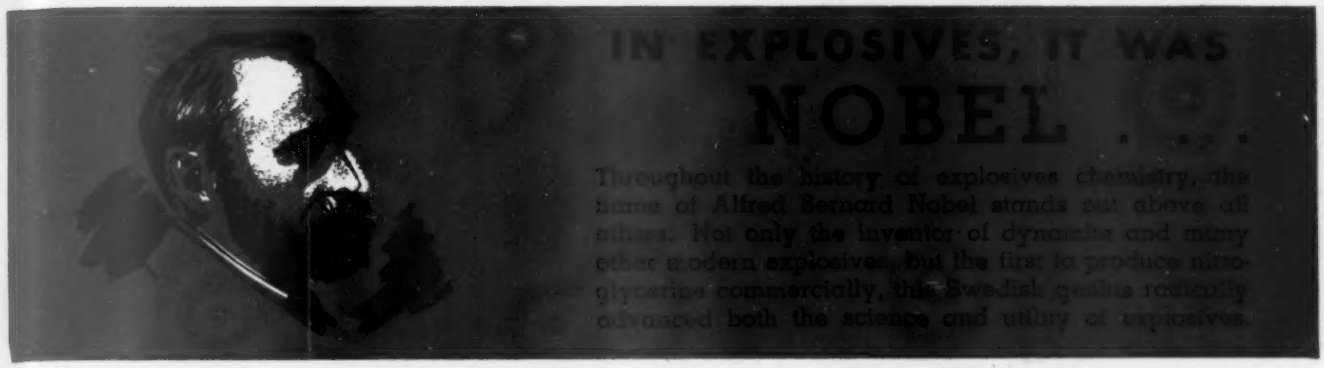
(3)—The effect of various factors on the spectra of pure compounds, such as the temperature of the ion source.

(4)—Recording. Special requirements for the recorder are that it shall have wide range and high speed. Preferably it should be a pen recording system rather than photographic.

Stable electrical circuits have been developed to permit ignoring of these controls during an analysis. These compensate for variations in line voltage supply and, in fact, are similar to those used in other devices for measuring and handling delicate currents. Various types of throttling devices are used in assuring that the mixture which gets into the ionization chamber is representative of the sample taken for analysis. The difficulties attendant on mixtures wherein some components are gaseous while others are liquid at the usual ambient room temperatures were discussed, along with the factors which may make for variations in the spectra of various pure compounds.

The second paper was "Industrial Mass Spectrometry" by H. W. Washburn, H. F. Wiley, S. M. Rock and C. E. Berry, Consolidated Engineering Corp. It dealt for the most part with the use of the Consolidated instrument for various kinds of analyses. Experience has shown, the paper stated, that the mass spectrometer is well adapted to the determination of small amounts of a substance (contaminant) in a mixture or a pure substance; the analysis of mixtures containing hydrogen, helium, nitrogen, etc.; the analysis of wide-range mixtures, such as hydrogen and C_1-C_5 paraffin olefin mixtures obtained from cracking still overhead; determination of key components from simple mixtures, such as butadiene and styrene in a mixture containing C_4 and C_5 olefins and diolefins, styrene, ethylbenzene and butadiene dimers; and analyses of mixtures containing a large number of isomers, such as a mixture of C_6 paraffins and cyclics. It also was brought out that the instrument can be used to analyze mixtures containing oxygenated hydrocarbons, such as ketones and aldehydes, although work is still being done on mixtures which contain alcohols.

Among other papers of interest to the oil industry was "Styrene Production by Catalytic Dehydrogenation Low Pressure Operation," by J. M. Mavity, E. E. Zetterholm and George Hervert, Universal Oil Products Co. It discussed the catalytic dehydrogenation of ethylbenzene to styrene in terms of laboratory investigations of such operating variables as pressure, temperature, space velocity and process period length on conversion, styrene yield and extent of carbon deposition, using UOP commercial dehydrogenation catalyst. Ranges considered in the UOP investigations were pressures of 80 absolute to 50 psig and temperatures from 550 to 630°C. (1022 to 1166°F). The laboratory process thus developed is reportedly quite selective, and indicated ultimate yields as high as 90% reported.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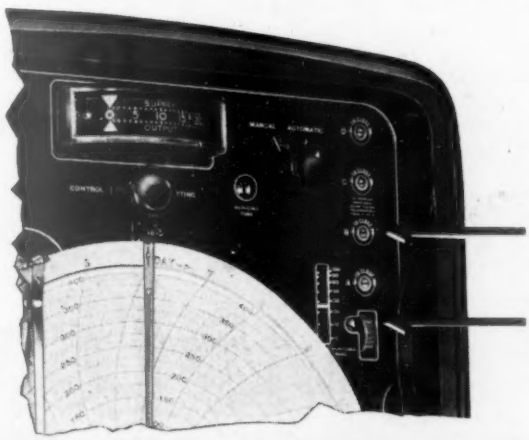

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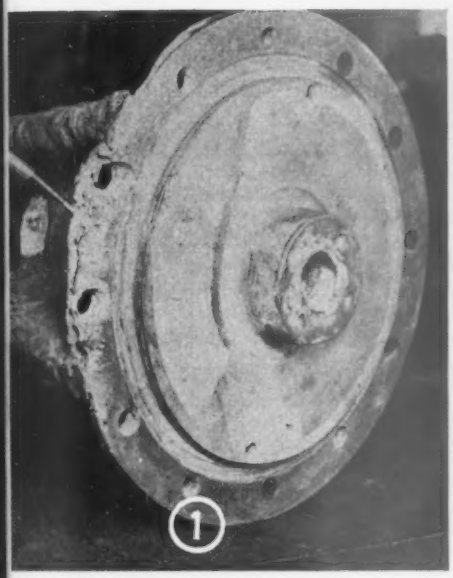
Pump Salvage Saves Months of Delay, Keeps Vital Production Going



*By J. Barrie Graham**

When you can't get delivery in less than six months to a year on replacement parts for your equipment, then the next best thing to do is to fabricate the parts yourself.

That's exactly what the Mechanical Department at the Toledo refinery of Standard Oil Co. (Ohio) had to do recently when they received a call to repair the packing gland on a constant displacement rotary type pump in use at the refinery's alkylation plant.

The Toledo plant of Standard of Ohio is the only refinery in Ohio which is making finished 100-octane aviation gasoline, and complete failure of any piece of vital equipment would seriously hamper its production.

The pump in question is used in the reactor recirculating system, pumping approximately 1580 b/d of 90-93% sulfuric acid at a temperature of 40-50°F. Driven by a 7½ hp motor at a speed of 1135 rpm, the pump has a suction pressure of 15 psi and discharge pressure of 20 psi.

When the machinist sent out to handle the packing gland repair job inspected the pump, he found both end shell covers corroded to such an extent that renewal of both covers was necessary. Because of the long delay in obtaining replacement covers from the manufacturer, it was decided to fabricate new ones in the refinery's own machine shop, using odds and ends of metal which were available.

Fig. 1 shows corrosion on the lower portion of the original end plate, a result of acid leakage. Corrosion around the stuffing box, which permitted excessive leakage through the packing, is shown in Fig. 2. Both end plates were corroded in a similar manner.

In making up the new pieces, the cover plate, with both inside and outside bosses, was machined from heavy boiler plate. A hole was bored through the center of this piece, the diameter of the hole being slightly less than the finished shaft diameter. The bearing housing was then machined on the outside and a small hole drilled through the center. These two pieces were held in their relative positions by means of a special arbor while the support brackets were welded to both pieces.

This assembly was chucked in the lathe and the inside surface of the plate machined. While the piece was still in the lathe, both the stuffing box and the bearing housing were machined to final dimensions.

Both covers were made in this manner and are identical except that the inboard bearing housing is tapped out to accommodate the inner and the outer thrust bearing adjusting nuts.

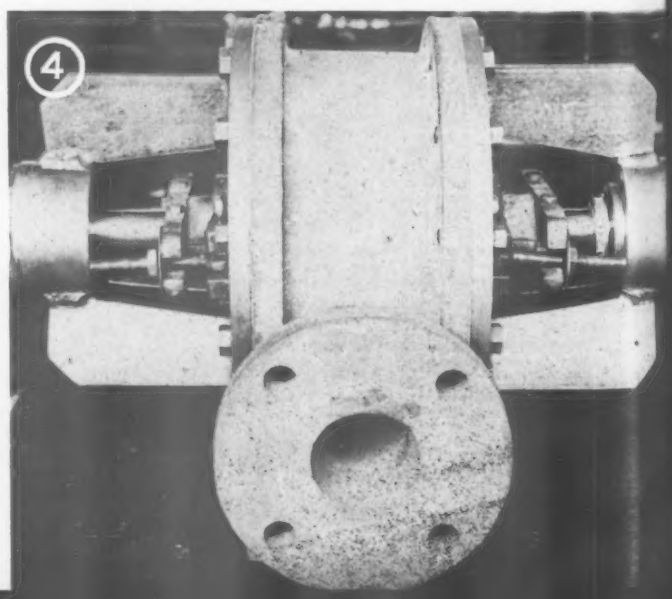
Fig. 3 shows the newly fabricated end shell cover for the inboard side of the pump. This picture also illustrates the method of attaching the lugs for the packing gland bolts.

The shaft in the original pump was also badly worn, so a new shaft was made by turning down a larger worn shaft that had been removed from a reciprocating pump.

The repaired pump, completely assembled and ready for installation at the alkylation plant, is pictured in Fig. 4.

According to reports from the refinery, its performance after installation proved to be equal in every way to the performance of the original pump.

This repair job is but one of many salvage jobs being performed by Standard's maintenance men in these days of urgent production and restricted replacement parts. Improvising of such a nature has played an important part in helping refineries to keep the production of petroleum products for our armed forces at the maximum possible output.



*Metal Inspector, Toledo Refinery, Standard Oil Co. (Ohio).

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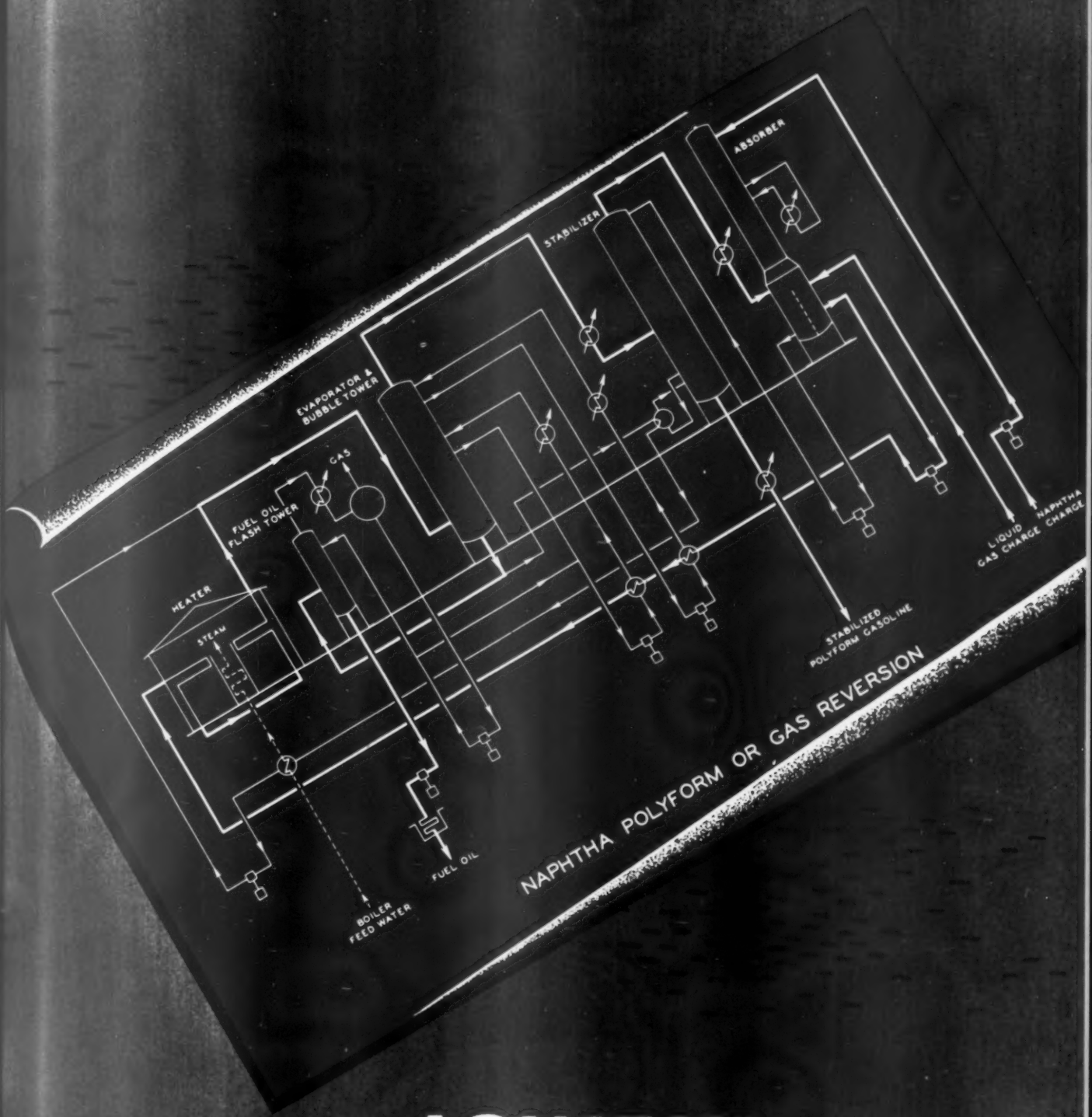

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During the present emergency, Polyform gasoline is being retreated over TCC and Houdry units for the production of high quality aviation gasoline base stock; also, Polyforming is producing large quantities of butylenes for both rubber and aviation alkylate.

The flowsheet on the preceding page illustrates the simplicity and ease of operation of a Lummus Naphtha Polyform Unit. Lummus has engineered and built over 80% of the Polyform plant capacity now in operation.

The combination of increased octane number and overall higher yields of gasoline makes the Polyform Process economically attractive to the refining industry. It offers flexibility in meeting varying refinery octane requirements and in utilizing excess propanes and butanes economically. For further information write to: THE LUMMUS COMPANY, 420 Lexington Avenue, New York 17 . . . 600 South Michigan Avenue, Chicago 5, Illinois . . . Mellie Esperson Building, Houston 2, Texas . . . 634 S. Spring Street, Los Angeles 14, California . . . 70 Barn Hill, Wembley Park, Middlesex, England.

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Aviation Gasoline Advisory Committee Brings Leading Petroleum Technologists and Executives Together To Pool Knowledge and Experience on Manufacturing Problems

TO PROMOTE the co-operation and exchange of information among oil companies which wartime refining has made necessary, many of the nation's leading petroleum technologists and executives have been assembled on numerous committees and boards.

Among the most outstanding and successful of these groups has been the Aviation Gasoline Advisory Committee, a group of 17 refinery technical and operating men, selected and appointed by the Petroleum Administration for War to co-operate with it as experts and advisers on how to improve manufacture of aviation fuels.

Although all of its members are active industry men, AGAC is not, strictly speaking, an industry committee. Neither is it a government group, even though it was originated by PAW and reports to PAW's Refining Division. The men who make up the committee function as individuals, rather than as representatives of their respective companies, working together to solve a common problem.

AGAC was first organized in September of 1942. At that time PAW (or rather its predecessor, OPC—Office of Petroleum Coordinator) recognized that it needed a staff of expert refinery technologists and executives to offer advice both to the government and to the industry on how to obtain maximum production of aviation gasoline from existing and planned facilities, and to make recommendations on the expansion program which would be necessary to meet all requirements not provided for by present equipment.

A committee of the leading technical men from the country's oil companies—men who would still carry on their company connection and thus remain a part of the industry—seemed to be the answer. The Aviation Gasoline Advisory Committee was the result.

Originally, AGAC consisted of 10 members and two alternates. In the spring of 1943 the alternates were made full members, and three new members were added, making the total membership 15. About six months ago an additional two members were appointed, so that at the present time the membership is 17.

Meetings of the committee are held every one or two months, depending upon how much work it has in progress and what problems may have come up since the last meeting. A representative of the British Government in this country usually attends all meetings in order to coordinate the aviation gasoline programs of the two countries.

Chairman of AGAC is Harry G. Burks, Jr., a director of the Standard Oil Co. of N. J. (Delaware). Dr. Burks has been with Standard of N. J. since 1924, and with the Delaware company since 1927. He was named manager of the company's technical service division in 1935, manager and technical advisor to the vice president in charge of manufacturing a year later, and assistant to the president in 1940. He became a director in 1943.

The other 16 members at the present time include:

R. C. Alden, Director of Research for Phillips Petroleum Co. In the oil industry since 1920, Mr. Alden joined the research staff of Phillips in 1925, was made assistant director of research five years later, and took over his present position in 1933. In his work with Phillips he has had an active part in pioneering developments of aviation fuel manufacturing processes, and in testing methods and experimental evaluations of aviation fuels.

Dr. Harry G. Burks, Jr.
AGAC Chairman

George A. Davidson, Vice President of Standard Oil Co. of Calif. Mr. Davidson went to work with Standard of Calif. in 1921 in the research department, and has been in research and manufacturing positions ever since. He was elected to his present position last May, after having been appointed assistant general manager of the manufacturing department and assistant vice president the previous year.

C. E. Davis, General Manager of Manufacturing, Shell Oil Co. For more than ten years, Mr. Davis has been closely associated with the development and growth of 100-octane aviation gasoline. In 1933, after 16 years in various positions at Shell refineries, Mr. Davis went to St. Louis as assistant to the manager of the manufacturing department. In 1938 he was appointed assistant to the vice-president of manufacturing, and two

R. C. Alden

Monroe E. Spaght

J. H. Forrester

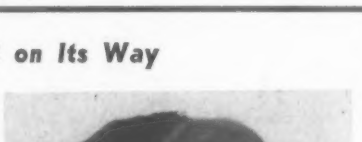
P. L. Smith

He started AGAC on Its Way

MAIN organizing force in getting the Aviation Gasoline Advisory Committee functioning was Robert B. Cragin, until recently assistant director of PAW's refining division. Before being loaned to PAW three years ago, Mr. Cragin was with the M. W. Kellogg Co. as director of petroleum research. He was later a sales engineer with the same firm.

With PAW he was closely associated with the aviation gasoline program, and quickly recognized the need for an industry group such as the AGAC in order to obtain the necessary cooperation and exchange of information among the nation's refiners.

At the present time, Mr. Cragin is with the Houdry Process Corp. as vice president in charge of sales engineering and as a technical advisor.



Robert B. Cragin

years later became manager of that department in New York. He was appointed to his present position in August of last year.

Hugh W. Field, Assistant Manager, Research and Development Department, The Atlantic Refining Co. Mr. Field has been with his company for over 16 years, starting as a junior engineer in the process division. He subsequently moved into the research and development department, where he worked as a senior engineer and later as a supervising engineer before assuming his present position.

J. H. Forrester, Associate Director of Research of the Standard Oil Co. (Ind.). Mr. Forrester has been with the research department of that company for the past 15 years, and is in charge of Technical Service, providing technical assistance to the manufacturing department. His wartime activities have also included work on subcommittees of the District 2 Refining Committee, and on PIWC's Technical Advisory Committee.

E. C. Herthel, Manager of Research and Development, Sinclair Refining Co. Mr. Herthel has held that postion for the past 20 years. He went with Sinclair in 1917 in refinery operations and development work, and was later assistant manager of refineries before taking over his present position.

Basil Hopper, Vice President in Charge of Manufacturing, Union Oil Co. of Calif. Employed by Union Oil Co. in 1923, Mr. Hopper's early work consisted of laboratory research, plant development and operation; he was later in charge of plant processing, pilot plant development and operation of new plants through performance testing. In 1939 he was made manager of research, adding direction of laboratory research to his other duties. In Sept. 1941, he became manager of manufacturing, in charge of all refineries, and last June was elected vice president in charge of manufacturing.

H. Y. Hyde, General Supervisor, Research and Development Department, Tide Water Associated Oil Co., Western Division. Mr. Hyde has been with the firm since graduation from M.I.T. in 1927, and has held his present position for more than 15 years. He has further participated in the petroleum industry's war program as a member of the Technical Advisory Committee of PIWC, and on the Aviation Gasoline Subcommittee of the District 5 Refining Committee.

E. J. Kirberg, Process Engineering Department, Gulf Oil Corp. Mr. Kirberg started with Gulf in 1922 in the engineering department at the firm's Port Arthur refinery, where he was later head of the testing department and superintendent of pressure stills. Since joining the process engineering department in Gulf's main offices in 1936 his work has been mainly concerned with the processes and manufacture of aviation gasoline.

Elliott B. McConnell, Vice President in charge of Manufacturing, Standard Oil Co. (Ohio). Mr. McConnell started his career in the refining industry with Standard Oil Co. of N. J., coming to Standard of Ohio in 1927, and moving up to his present position a year later. For five months in 1942 he was "loaned" to the government as Special Technical Assistant to the Director of PAW's Refining Division. He has also been active on the Technical Advisory Committee of PIWC.

Arthur E. Pew, Jr., Vice President in charge of Manufacturing, Sun Oil Co. Mr. Pew has held that position since 1930, and for four years prior to that was Sun's chief engineer. He began his oil career in Sun's production department. During World War II he has also served as vice chairman of PAW's Committee on Refining for District 1.

P. L. Smith, Technical Director, Magnolia Petroleum Co. Mr. Smith went to work with Magnolia at Beaumont in the laboratory in 1923, becoming assistant chief chemist in 1926 and chief chemist in 1936. He was appointed to his present position in 1938. Since the war started he has been actively engaged in the work of the District 3 Refining Committee, serving as chairman of the Technical Subcommittee.

Monroe E. Spaght, Manager of Research and Development for Shell Oil Co., Inc., Pacific Coast. Mr. Spaght started with Shell in 1933 as a research chemist, and was later technical assistant and refinery chief technologist at Shell's Wilmington refinery. He took over his present duties in 1940, and during the past three years he has directed the planning and development of Shell's $25,000,000 war plant expenditures on the Pacific coast.

Clark S. Teitsworth, Vice Chairman of Manufacturing Committee, Socony-Vacuum Oil Co., Inc. Mr. Teitsworth came

C. E. Davis

E. C. Herthel

George A. Davidson

H. Y. Hyde

to Socony-Vacuum, in 1934 from General Petroleum Corp. with the specific assignment of determining if catalytic cracking had been developed sufficiently for commercial use in its refineries and affiliated companies. In 1936 he was appointed to the manufacturing committee as manager for Midwest refineries, at the same time continuing to follow the progress of development and construction of commercial catalytic cracking units.

H. D. Wilde, Head of Technical and Research Division, Humble Oil & Refining Co. Mr. Wilde has been with that company since 1927, when he started working in the laboratory at its Baytown refinery. His work was primarily in the field of light hydrocarbons until 1929, when he was transferred to Houston to organize and head up a new group to conduct research work in the production department. He was transferred back to the refining department and his present position in 1933. Mr. Wilde, besides his AGAC work, has been active in the work of Industry Committees of District 3, particularly during the early work of the Technical Subcommittees on Aviation Gasoline, Refinery Conversion (synthetic rubber), and Operations.

John S. Worden, Manager (Operations) of the Refining Department, The Texas Co. Mr. Worden has been employed by The Texas Co.. since 1921. After serving in many capacities in the refining department and at various refineries of the company, he was transferred to the New York office as assistant manager (operations) of the refining department. He became manager of operations in May of 1942.

The person probably most responsible for conceiving the idea of AGAC and getting it organized is R. B. Cragin, formerly Asst. Director of Refining for PAW and now with Houdry Process Corp. B. K. Brown, PAW Asst. Deputy Petroleum Administrator, was also instrumental in its organization.

Executive secretary for AGAC and at present the main contact between PAW and the committee is Major R. M. Cornforth, who has been with PAW for nearly three years and was previously in the Research and Process Development Dept. of Standard Oil Co. (Ind.). Phillip J. Byrne, chief of the Technological Section of PAW (*see NPN Technical Section, Oct. 4, 1944, pg. R-663*), follows the work of the committee from Washington and attends all of the meetings.

One of AGAC's primary functions has been to make recommendations to PAW on various technical questions, acting in an advisory capacity. Perhaps even more important, however, is the work it has done with the individual refiners in helping them increase their production of aviation gasoline components from existing facilities.

This it has accomplished in three ways:

1) By making available to all operators the results of the work of those who have been most successful in developing the best operations. For example, refiners A and B both have the same type of unit and are operating under much the same conditions, but A obtains only 75% of the yields that B gets. In this case the more efficient methods developed by B are passed on to A so that he can boost his yields.

2) By effecting a constructive review of each refiner's specific operations by a group of specialists. In this manner even the smallest refiner, who would normally be unable to maintain expert technical and research staffs on all the phases of refining, is able to get the advice and experience of technologists who are thoroughly familiar with his particular operations.

3) By obtaining first-hand information concerning problems requiring further attention.

In order to concentrate the necessary effort on this phase of its operations, the committee has handled most of this work through subcommittees, each formed to deal with a specific type of operations. So far, ten of these subcommittees have been formed:

Subcommittee	Chairman
Additives	M. E. Spaght
Alkylation	J. S. Worden
Aromatics	H. W. Field
Aviation Base Stock Production	E. C. Herthel

Former Members of AGAC

DURING the more than two years that the AGAC has been operating, only two of the original members have been lost. In the spring of '43 D. E. Carr of the Union Oil Co. of Calif. resigned, and his place was filled by Mr. Hopper. And early this year Victor Stapleton, then with The Texas Co., resigned and PAW appointed Mr. Worden to succeed him.

D. E. Carr

V. Stapleton

Mr. Carr is Manager of Research with Union Oil, having been with the firm since 1930, first as a research chemist specializing in lubricating oil technology and later as research supervisor in charge of lubricating oil investigations. He became manager of research in 1941.

Mr. Stapleton was Supervisor of Processing of the Research Department with The Texas Co. before he resigned recently to enter the service of the Arabian American Oil Co. He was one of the first members appointed to AGAC, had a good deal to do with the organization and initial groundwork of the committee, and was the original chairman of the Alkylation subcommittee.

Arthur E. Pew, Jr.

Hugh W. Field

Clark S. Teitsworth

Basil Hopper

Blending Octane Numbers	J. H. Forrester
Catalytic Cracking	C. E. Davis
Codimer Operations	E. B. McConnell
Isomerization	R. C. Alden
Toluene Plant Conversion	H. W. Field
Treating of Catalytically Cracked Gasoline	C. S. Teitsworth

In organizing each of these subcommittees, the procedure generally followed has been to appoint a committee member to serve as chairman and to request members of the committee to select qualified individuals to serve as members. These members are generally from the oil industry, but in some cases are connected with licensing agents carrying out a substantial amount of research work. In this manner each subcommittee is composed of specialists in its particular field.

The manner in which the individual subcommittees function and carry on their work varies with the different ones. Some of them merely gather data on their particular phase of operations (for example the subcommittee on Blending Octane Numbers) and submit it to the industry in the form of reports.

Others, however, have found it necessary to develop an extensive program for gathering information and then disseminating it to the industry. They have done this in various ways, but the procedure devised by the Alkylation subcommittee members is quite representative of most of them.

First of all they gather and correlate all available data on their phase of operations—alkylation. This they do by circulating questionnaires among the various refiners, by personal visits to plants with alkylation units, and by working through the Technical Advisory Committee of PIWC.

After the available data have been collected, all the refiners in one section of the country who are concerned with alkylate manufacture are gathered together in a group meeting at which are discussed in detail all the "tricks of the trade" which, if followed, will permit obtaining from a typical unit the greatest production. This procedure is repeated in other sections of the country, so that all of these small groups taken together comprise all present and approved future manufacturers of alkylate.

Maj. Robert M. Cornforth
Executive Secretary

At these same group meetings the subcommittee on alkylation goes over in detail the operations of each refiner present to determine the capacity of his particular unit, what limits its production, what has to be done to remove the limitation, and any particular operating problems he may have.

Following these group meetings, the alkylation subcommittee prepares a detailed report for each of the refiners, outlining its recommendations as to how that refiner can further improve his operations. A copy of the report is also sent to PAW for whatever action and follow-up that group may deem desirable.

The group meetings aren't attended solely by the members of one subcommittee and the refiners concerned. Quite frequently members of another subcommittee will also be present. The purpose of this coordination of the work of the subcommittees has been to insure that the facts available to each were brought to bear upon the interrelated operations of the different processing units in each refinery. Only by such coordination has it been possible to assure the maximum overall production of aviation-gasoline components and of the raw materials necessary for their production. Quite frequently recommendations have been made to PAW pertaining to inter-refinery movements of raw materials in order to utilize, in so far as possible, all available equipment capacity to maximize overall production.

As a further means of insuring that operating "know-how" on a particular process is quickly made available to all of the operators of that particular type of unit, a number of the subcommittees have installed a system of having the refiners contribute monthly reports, outlining important features of their operations for that month, together with operating difficulties encountered and steps taken to overcome them. These reports are summarized by the subcommittee concerned and then reissued to all of the operators of that particular type unit, so that they may benefit from the experience of others.

The amount of work involved in any such program as has been carried out by AGAC is tremendous, particularly when you consider that all of the main committee and subcommittee members still have their usual company activities and duties to carry on.

The exact extent of the work which AGAC has accomplished isn't something which can be measured by any known yardstick. It's impossible to separate its accomplishments from those of PAW on the one hand, and of the aviation gasoline manufacturers on the other.

It's generally admitted, though, that the production records which the petroleum industry has established in manufacturing aviation gasoline couldn't have been obtained without the unstinted co-operation of the various companies, and the pooling of their technical knowledge and skill. And a great deal of this co-operation and pooling has been a direct result of the activities of AGAC.

As Mr. Cragin recently expressed it, "If there had never been an AGAC, there would have been a good deal less aviation gasoline."

H. D. Wilde

Elliott B. McConnell

John S. Worden

E. J. Kirberg

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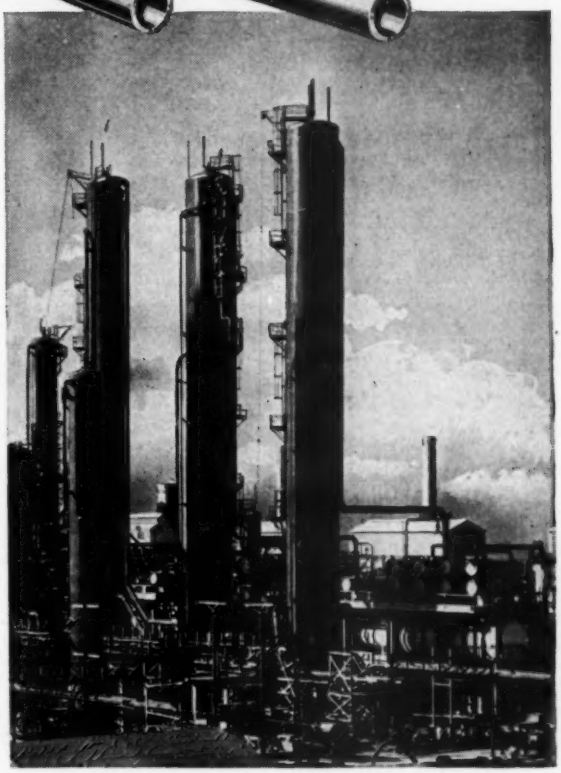

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PROCESSING OF LUBES MODERNIZED*

Tower Propane Deasphalting with Improvements in Phenol Extraction and Other JUIK Processes Provide High Viscosity Index Oils from Wide Range of Crude Stocks.

A GROUP of solvent processes for refining lubricating oils, including phenol extraction, have been modified and improved according to latest research findings to make oils of either high or low viscosity index from all types of crudes.

While the fundamental principles of these processes are not new—most of them being known to refiners as the "JUIK processes"—the equipment has been re-engineered to cut operating costs and enhance the quality of the products. The research making these developments possible has been carried on in the laboratories of the companies comprising the JUIK group; Standard Oil Co. of New Jersey; Union Oil Co. of California, Standard Oil Co. (Indiana) and The M. W. Kellogg Co.

A growing number of full-scale installations are in successful operation. The processes include propane tower deasphalting, propane dewaxing, acid treating in propane solution, clay contacting in propane solution and phenol extraction. These individual steps may also be combined for a single overall operation.

If entirely new equipment is to be installed there are several general plans for combinations. A complete propane series for the production of bright stocks includes the use of propane tower deasphalting, acid treating in propane solution and clay treating in propane solution—with or without the propane dewaxing step. Another series of processes combines propane tower deasphalting with phenol solvent extraction and propane dewaxing. In this latter series clay treating if necessary can easily be added following the dewaxing step while the stock is still in propane solution.

A variation of propane tower deasphalting permits the separation of lube fractions as well as deasphalting. Fractionation in propane solution eliminates need for vacuum distillation and also eliminates the possibility of "cracking" some of the lube fractions, a danger encountered in the last stages of vacuum distillation. The same method and equipment used for tower deasphalting is used for propane fractionation, the only changes required being operating conditions.

The various processes, considered as single units, are treated here in the same order as introduced above, then discussed in combination, followed by overall cost considerations.

Propane Tower Deasphalting

Any reduced crude can be successfully deasphalted in propane solution, it is said. The old "stage" method is familiar to refiners, but the latest innovation of tower deasphalting is comparatively recent, combining as it does the possibility of fractionating stocks into various cuts as well as deasphalting, all without recourse to vacuum distillation. To visualize the improvement represented by the tower

*This article is based on data contained in the report "Stepping Up the Dollar Value of Crudes in the Processing of Lubes," published by The M. W. Kellogg Co., and on interviews of an NPN Technical Section staff writer with technologists of the company. Illustrations were supplied by The M. W. Kellogg Co.

Propane tower deasphalting unit in an aviation lube treating plant

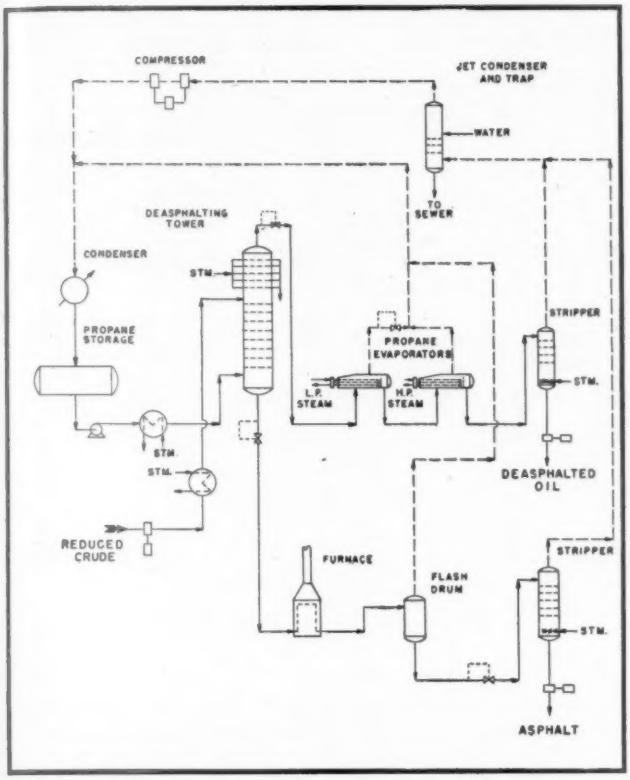

Fig. 1—Flow sheet of propane tower deasphalting process

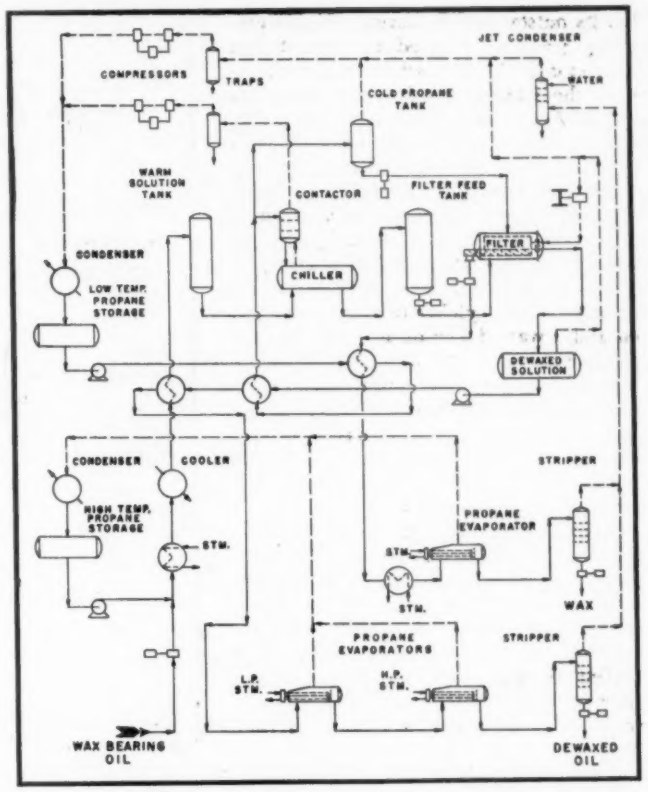

Fig. 2—Schematic diagram for propane lube-dewaxing plant

process, it might be said that propane tower deasphalting bears the same relation to stage deasphalting as bubble tower fractionation does to single flash distillation.

Deasphalted oil of from 5 to 8 N.P.A. color can be produced at relatively low cost with this method, it is said, regardless of the asphalt content of the original reduced crude charged. Carbon content is materially reduced, ranging from .75% to 2.25% by the Conradson test on deasphalted oils from a variety of reduced crudes. Asphalt ranging from 115 to 180°F. melting point resulted from deasphalting a selection of different crude residues (Table 1). Viscosity-gravity constants for the lubricating stocks are slightly lower in value than for the original reduced crude.

Referring to the process diagram, Fig. 1, reduced crude is charged near the middle of a deasphalting tower through a preheater at a temperature depending on what finished oil characteristics are required. Propane, similarly preheated, is charged at the bottom. The asphaltic lower phase moves down the tower and is effectively scrubbed by the upcoming stream of propane so as to remove all "good" oil from the asphalt which is continually withdrawn from the bottom. The "good" oil upper phase is further rectified between the oil feed point and the top of the tower. The temperatures maintained at the top and at the bottom of the tower also depend upon the character of the feed stock and can, of course, be varied to control the nature of the products secured.

Tower overhead passes through two propane evaporators, heated respectively with low- and high-pressure steam, where the bulk of the propane is removed, and thence to a stripper which eliminates the last traces of solvent. Asphalt phase, bottoms, passes through a simple direct fired heater in single pass, increasing its temperature to about 450°F. thence to a flash drum where most of the propane is eliminated, and to a steam stripper where the balance of the propane goes overhead with the asphalt taken off as bottoms. Propane, removed from both oil and asphalt as vapor in the strippers, is freed of steam in a jet-condenser-and-trap, compressed, condensed and returned to storage.

Tower top temperatures above 200°F. are seldom required. At or near 206°F. (the critical temperature of propane) composition of the upper phase is nearly pure propane, which fact permits overhead composition to yield a lube fraction as low as the stock being charged will permit. It appears that good practice would recommend cutting as deeply as possible by distillation at atmospheric pressure and then fractionating the atmospheric residue with propane.

Most important feature of the process is that it permits reduction of bottoms (asphalt) reject to a very small percentage of crude, but at the same time produces a high quality deasphalted oil and high melting-point asphalt. Propane ratio employed is generally 8 volumes of propane to one of oil, although (Table 2) higher ratios are used in the case of some reduced crudes.

Table I shows propane tower deasphalting yields from typical samples of reduced crudes. Note in the case of Coastal stock that original viscosity was 1764 Saybolt secs. at 210°F., carbon residue 16.2%. The deasphalted oil produced was 51.4% of charge, had 8-N.P.A. color, 161.2 SSU viscosity and 1.74% carbon residue. Produced at the same time was a 164°F. melting point asphalt with zero ductility and 1.5 penetration. Similarly, a Mid-Continent stock showed original viscosity of 1716 and carbon residue of 15.2%; deasphalting produced an oil yield of 54% with 150.8 viscosity, 5-color and 1.55% carbon. The asphalt again was high melting, 178°F., with zero ductility and 4 penetration.

Propane Tower Refraction

Propane tower fractionation is a logical outgrowth of tower deasphalting, but as yet is still undergoing laboratory investigation before commercial release. With a tower designed for the purpose, proper control of operating conditions permits the removal at intermediate points of fractions having viscosities and other characteristics between those of the top and bottom products.

Propane Dewaxing

Propane dewaxing has been in successful commercial use for many years, along with other well-known processes. While the fundamentals remain unchanged, important improvements in the design of plants have been made by Kellogg. High capacity continuous pressure filters are now standard equipment. Process still

has its outstanding features; a single material, propane, is used as diluent and refrigerant. Water, which may accompany the waxy stock, does not constitute a problem. In combination with the other propane-solution processes of deasphalting, acid-and-clay treating, it becomes necessary to handle only one mixture of oil with propane for the whole improvement from reduced crude to finished stock and one stripping operation.

Any charge stock may be dewaxed, resulting in high yields of zero pour test oil and a wax of low oil content. It is in commercial use for dewaxing distillate and residual oils; Pennsylvania, California, Mid-Continent, Louisiana, Texas and Gulf Coast oils; raw distillates and deasphalted reduced crudes; raffinates from solvent extraction and oils of very low and very high wax content.

Briefly, as shown in the flow sheet (Fig. 2), the waxy charge is mixed with propane, preheated and then goes through a pre-cooling train to a chiller, where temperature is finally reduced to approximately −40°F. by autorefrigeration. The chilled solution then passes to a continuous rotary filter where it is freed of wax. The cold, dewaxed solution then is heated (after exchange against incoming oil and propane) and passed in series through low and high pressure steam-heated evaporators, the bulk of propane being recovered as vapor at this point and passing directly to condensers. Oil finally is stripped with steam to remove last traces of propane. Wax leaves the filter as a slurry in propane, passing successively to a high pressure steam propane-evaporator (temperature 250°F.) and stripper. Either a single or two-stage propane evaporator is provided for the wax-side of the process, depending upon wax content of stock for which the unit was designed.

The filter is of the external-pressure type instead of vacuum, which design avoids the handling of large quantities of propane vapors at low pressure. (See Fig. 3). Chilled waxy oil enters the bottom of the filter, operated nearly half full of liquid. Pressure of from 5 to 6 psig forces the oil through the filter. As the filter rotates the wax cake is sprayed with chilled propane until it reaches top dead-center, as shown diagrammatically in Fig. 4. Just before reaching the scraper, the wax again encounters a propane spray, designed to help loosen the cake and promote formation of propane-wax slurry in the screw conveyor at the outside edge of the scraper. Wax conveyor dumps slurry into the suction side of a wax pump; it is warmed, by exchange with propane from storage, on its way to the propane evaporator.

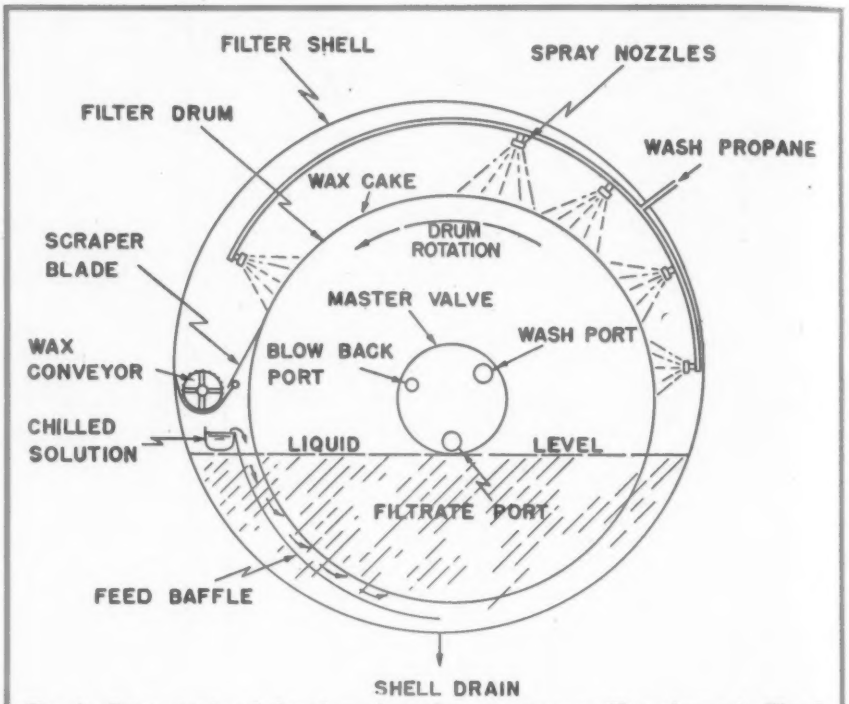

Fig. 4—Cross sectional drawing of continuous pressure filter shown in Fig. 3

Fig. 3—Battery of high capacity continuous pressure filters used in propane dewaxing of lubes. The internal rotating drum is shown in the opened shell in the foreground

Another saving in the process as presently developed (Fig. 2) is the use of waste heat as process steam. High-pressure steam from the mains drives compressors and pumps required for fluid-flow. Exhaust utility steam then becomes process steam for the low-pressure evaporators and pre-heat train. Only a small amount of high pressure steam for the final stage of propane evaporation is required.

A propane ratio of 1.5:1 to 3:1 is required, depending upon the viscosity of the charge stock. In Table 2, representing the dewaxing of a phenol-extracted 15% East Texas reduced crude for aviation lubricant, wax-free oil yield of 61.6%, with 118.4 SSU viscosity at 210°F. and zero pour test was obtained, using 3:1 ratio. Wax recovered had a melting point of 157°F.

Dewaxing may precede or follow solvent extraction or other stability improvement processes. Generally, however, it is most desirable for dewaxing to follow either acid-and-clay treating or solvent extraction. There are two reasons for this: (1) Since both investment and operating costs are higher for dewaxing than for other treating processes, lowest cost is usually secured by placing dewaxing as the last operation; (2) With dewaxing as the last step there is greater assurance of securing finished oils with minimum pour and cloud tests.

Propane Acid Treating

Propane acid treating is being used in a number of refineries as a continuous combination process with propane deasphalting. Acid treating is not necessary if the oil is to be phenol treated,

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TABLE 1—Tower Deasphalting Yields from Typical Reduced Crudes

REDUCED CRUDE	Coastal	East Texas		Rodessa	Panhandle	So. La.	Ranger	Heavy Oklahoma	Heavy Mid-C.	Penna.
Sample No.	B-3608	B-3467	B-4150	B-3468	B-4164	B-3475	B-4166	B-3474	B-3485	B-4149
°API Gravity	10.4	15.0	15.2	18.9	22.5	18.4	23.1	16.0	12.2	24.3
SSU Vis. @ 210°F.	1764	668	513	312	212	264	81.1	520	1716	208
Car. Res., %	16.2	11.6	10.9	9.2	5.9	6.5	2.8	10.3	15.2	3.1
Flash COC °F.	625	590	575	590	545	565	420	585	630	605
Fire COC °F.	700	665	665	680	615	635	465	665	695	665
V. G. C.	.908	.880	.882	.853	.834	.864	.846	.874	.892	.820
DEASPHALTED OIL										
Vol. % Yield	51.4	63.2	63.9	80.2	75.0	81.7	91.3	68.6	54.0	92.5
°API Gravity	21.3	23.0	23.6	23.9	26.9	22.7	25.3	23.4	22.3	25.5
SSU Vis. @ 210°F.	161.2	134.9	112.9	145.1	89.2	132.0	65.3	132.8	150.8	159.4
Color—N.P.A.	8—	8—	6	8—	5	8—	5—	5—	5—	7
Car. Res. %	1.74	1.63	1.32	2.11	0.79	1.30	0.76	1.26	1.55	1.61
Flash COC °F.	605	570	....	610	520	565	400	555	595	595
Fire COC °F.	675	650	....	675	605	630	460	645	655	665
V. G. C.	.847	.834	.836	.828	.815	.839	.835	.833	.840	.814
ASPHALT										
Vol. % Yield	48.6	36.8	36.1	19.8	25.0	18.3	8.7	31.4	46.0	3.5*
Spec. Grav.	1.0741	1.0485	1.0583	1.0662	.9993	1.0566	1.0379	1.0536	1.0603	1.0037
Melting Point °F.	164	153	165	172	118	172	143	165	178	123
Penetration, cm. x 10^{-3}	1.5	5	....	4	....	2	108+	4	4	....
Ductility, cm.	0	1	....	0	....	0	4	0	0	....

*Heavy resin fraction representing 4% reduced crude also made.
°API Gravity 16.8; Saybolt Furol Vis. at 210°F., 350.

since phenol alone (distillates) or deasphalting followed by phenol (reduced crudes) improves both color and stability. Important features of treating in propane solution are sharp reduction in acid requirement, from 8 to 15 lbs. per bbl. being the general range, and low sludge loss. The sludge, being insoluble in propane and of much greater specific gravity than the oil-propane phase, drops out quickly in a sludge settler. Propane is steam-stripped from the sludge as a final operation, likewise evaporated and steam-stripped from the oil. The propane deasphalting-acid-clay combination process shown diagrammatically in Fig. 5 is particularly suitable for the production of bright stock of conventional viscosity index or for treating oils having a naturally high viscosity index where phenol treating is unnecessary.

Clay treating in propane solution logically follows acid treating in propane, in which case propane is not removed from the acid-treated solution previously described. Prime feature of clay treating in propane is that only a relatively small quantity of clay is required to remove remaining acid and obtain any necessary further color improvement. There is no need to elevate temperature as in conventional clay treating for both color-and-stability improvement.

Mechanics of the process are indicated by the flow diagram (Fig. 5). Deasphalted, dewaxed and acid-treated oil

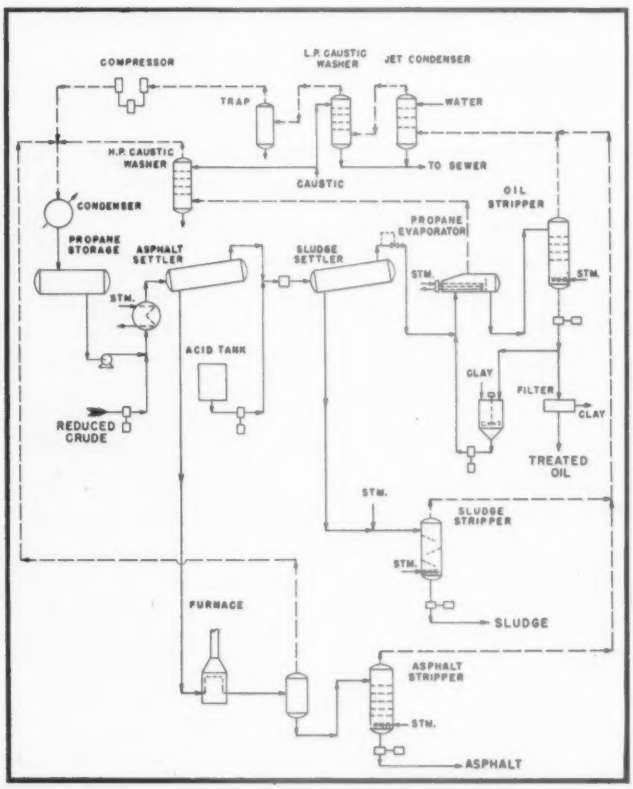

Fig. 5—Combination process diagram showing sequence of processing for stage deasphalting, acid treating and clay neutralizing in propane solution

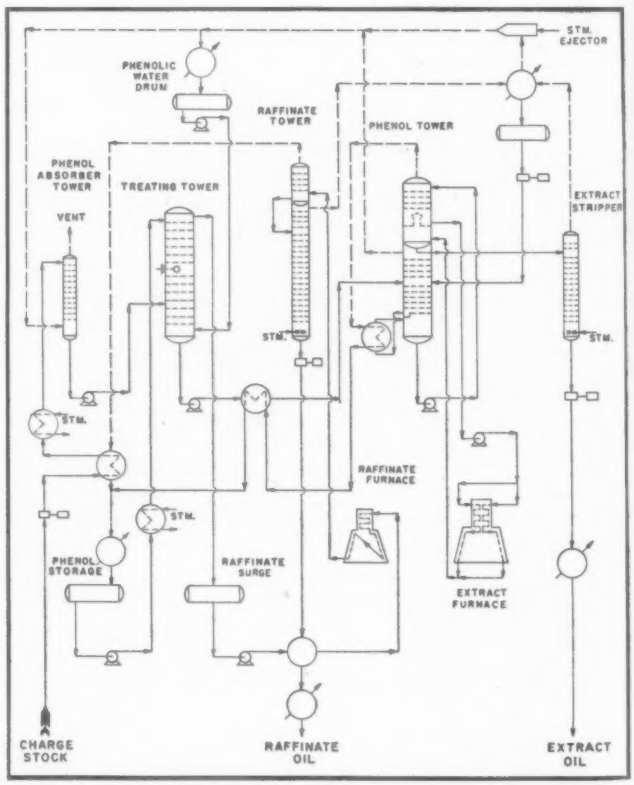

Fig. 6—Flow diagram for phenol solvent treating process for increasing the viscosity index of lube stocks

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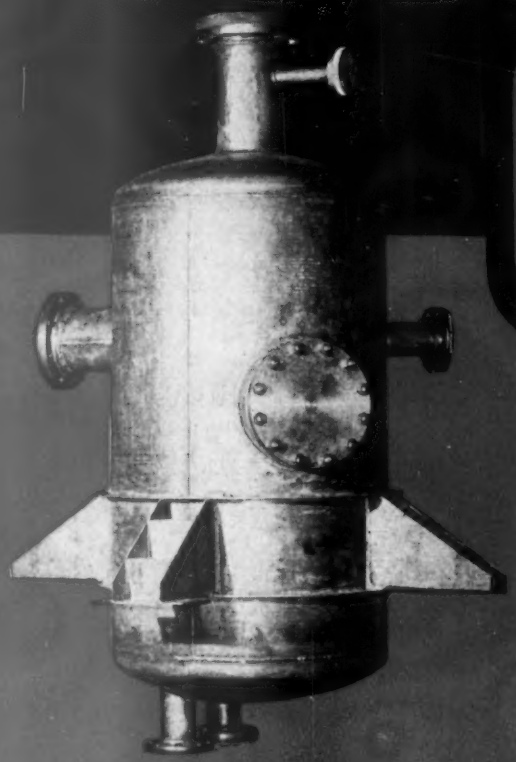

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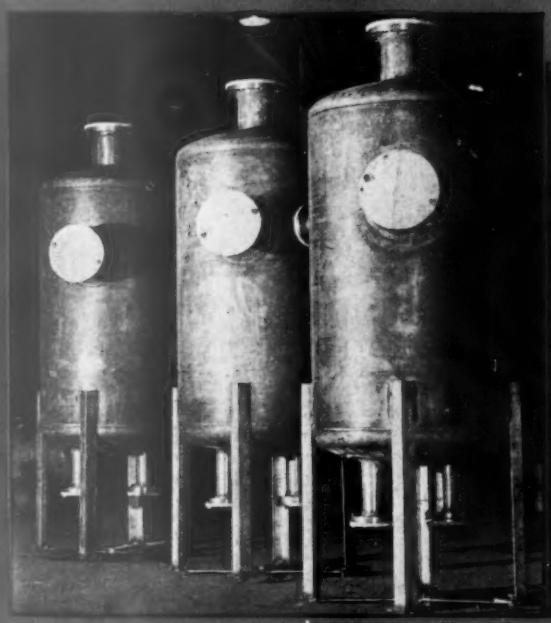

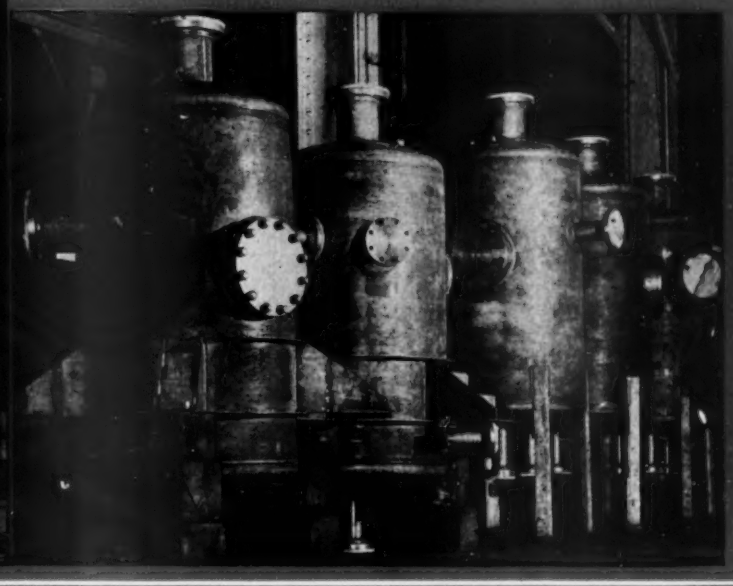

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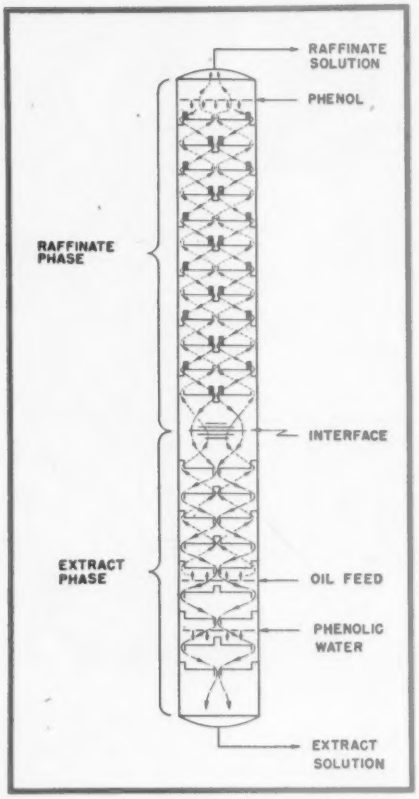

Fig. 7—Oil is intimately mixed with phenol in phenol treating tower. A special arrangement of baffles causes phenol streams to flow at 90° countercurrent to the oil streams and at same time effect a phase separation

in propane solution is charged from the acid-sludge settler to a propane evaporator, after first being contacted with clay by injection of a finished oil-clay slurry. Bulk of the propane is eliminated in the propane evaporator, the oil-clay mixture passing to a stripper for removal of last traces of propane, thence to conventional filters where clay is removed. A small side-stream off the stripper bottoms takes some of the unfiltered, finished oil to an agitator where it picks up fresh clay to form the finished oil-clay slurry.

Phenol Extraction

Phenol extraction to improve viscosity index of lubricating oils is not a new process. Its ability to remove naphthenic acids (high molecular weight straight-chain unsaturates) and to handle stocks of high sulfur content has long been known. Fundamentals of the process as first laid down in the old "stage" method have been unchanged through the years, the prime feature of Kellogg's experimentation being to develop a high efficiency, high capacity, low cost countercurrent treating tower. Heart of the process is this treating tower, while the other outstanding improvement over previous designs is the successful application of continuous water-rejection for improvement of treating efficiency.

Referring to the flow diagram, Fig. 6 it will be assumed the stock (if reduced crude) has been deasphalted. Charge stock is heated by exchange with steam to about 250° and passed through the absorber where it recovers phenol by absorption from the water leaving the plant as steam, and is then cooled before being charged to the lower part of the treating tower. Anhydrous phenol is charged to the tower at the top, Fig. 7. Phenolic water, water containing up to 10% phenol, enters the tower near the bottom.

There are in effect three different treating zones within the tower. In the upper section, a continuous raffinate phase is treated with descending anhydrous phenol. Below this zone a continuous extract phase is maintained through which incoming oil is treated as it ascends. Near the bottom, at the point where the phenolic water is introduced, the extract phase is modified so that the better portion of the oil initially dissolved by the phenol is rejected and again passes up the tower for further treatment. The extreme lower portion of the tower serves as a final extract phase accumulator.

Tower action is purely mechanical, as diagrammed in Fig. 7. Early installations of extraction units were based on the belief that violent agitation of the solvent and oil were necessary, but these encountered difficulty in separating all of the "good" oil from the extract. Mild agitation with cross flow as well as vertical travel are now employed in the phenol treating tower to secure improved efficiency with a tower of given height.

The treating temperatures employed vary with the character of the feed stock,

TABLE 2—Process Yield Table

15% East Texas Reduced Crude for Aviation Lubes
Charge: API Gravity, 15.6; SSU Vis. 210F., 484; Car. Res. %, 11.1; Flash C.O.C., F., 545; V.G.C. .879

Propane Tower Deasphalting Process		
Vol. % Propane	800	
	Deasphalted Oil	**Asphalt**
Products		
Vol. % Yield	68.4	31.6
° API Gravity	23.0	1.0627 (S.G.)
SSU Vis. 210° F.	122.2	167 (M.P.)
Color – N. P. A.	6	
Car. Res. %.	1.43	
Flash C. O. C. °F.	550	
V. G. C.	.838	
Phenol Extraction Process		
Vol. % Phenol	347	
	Raffinated	**Extract**
Products		
Vol. % Yield	57.4	42.6
° API Gravity	29.7	14.8
SSU Vis. 210° F.	93.1	
Color – N. P. A.	4½–	
Car. Res. %	0.20	
V. G. C.	.795	
Propane Dewaxing Process		
Vol. % Propane	300	
Filtering Temp. °F.	-34	
	Dewaxed Oil	**Wax**
Products		
Vol. % Yield	61.6	38.4
° API Gravity	27.6	157 (M.P.)
SSU Vis. 210° F.	118.4	
SSU Vis. 100° F.	1691	
Color – N. P. A.	4½–	
Color – O. D.	—	
Car. Res. %	0.26	
Solid Pt. °F.	0	
V. I.	95.0	
V. G. C.	.804	

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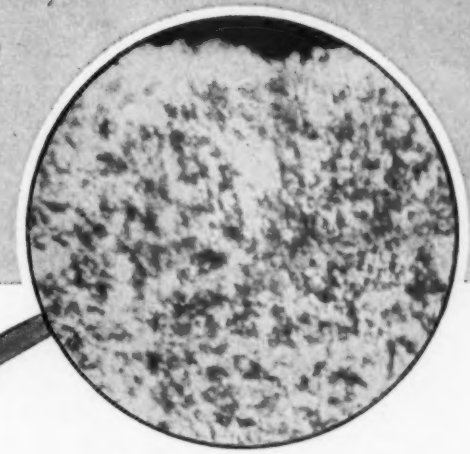
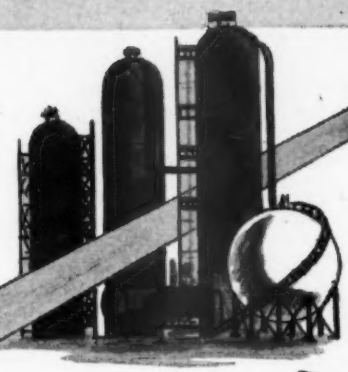


Microphotographs of thin sections made from actual FILTROL Catalyst pellets. Enlargement approximately 180x.



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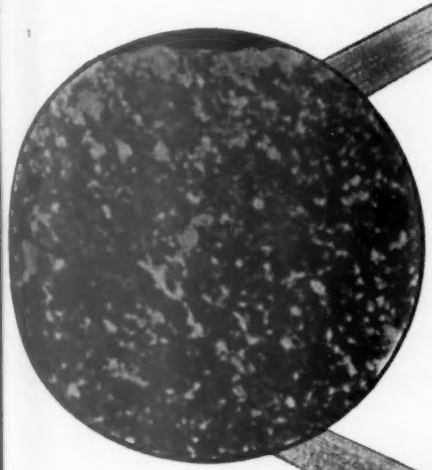
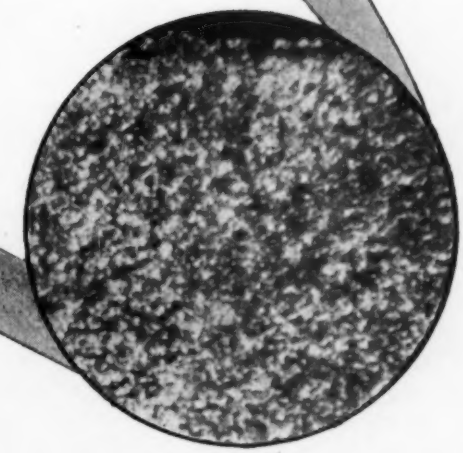
Showing prepared, crystalline Montmorillonite structure — chemically processed to assure superior porosity.



2. *USED . . .*

This superior porosity provides scores of acres of surface area—assures maximum "loading" through to the core and easy release of conversion products.



3. *REGENERATED*

Natural strength and stability—with pore size that allows full air access for interior and surface carbon burning—permits maximum regeneration of the entire pellet, insures uniform results in repeated re-use.

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ranging generally from 250°F. for high viscosity oil such as bright stock to 140°F. for low viscosity neutrals. The solvent power of phenol is in part accurately controlled in that portion of the tower below the point of water introduction by the amount of rejection water added. Overall, the solvent power of the phenol is, of course, established by the tower temperatures employed. What happens in the tower may be described as follows: The anhydrous phenol entering at top of the tower has maximum solvent power and thus controls the nature of the raffinate stream. The aqueous phenol at the base of the tower has minimum solvent power and thus controls what is allowed to pass out with the extract stream. The oil of intermediate quality is trapped between these conditions and thus is effectively fractionated so as to produce high yields of the desirable product.

Referring again to the flow diagram, Fig. 6, raffinate, or tower overhead, passes from the treating tower to a single-pass heater at 400°F, thence into the top section of the raffinate tower, where it is freed of phenol in two stages. In the first, most of the phenol is vaporized from the oil by simple distillation, anhydrous vapors going direct from tower top through a condenser to phenol storage. "Good" oil, plus the small amount of phenol still remaining, is removed from the pan in the top section of the tower for injection in the lower half of the tower. Here it is stripped with steam under vacuum, overhead being steam and phenol vapor, while bottoms is finished raffinate oil ready for dewaxing and/or other refining steps.

Extract oil at 120-180°F. is similarly taken to a dual-purpose phenol tower (Fig. 6), where, preheated by exchange with hot liquid phenol, it enters the lower section. The upper part of the tower, the phenol-oil separator, is divided from the bottom two-thirds of the tower by a pan. In the lower section, all water is removed as a phenol-water constant boiling mixture and the bottoms, composed of anhydrous phenol and oil, is pumped into the top of the phenol tower. In the top part of the phenol tower most of the phenol is removed from the oil by distillation, going to storage after giving up heat to the phenol tower reboiler and the incoming extract solution. A direct fired furnace coil, with outlet temperatures of 450°—500°F, supplies heat for vaporization of the phenol. Phenol remaining in the oil bottoms from this section is removed in the extract stripper with steam.

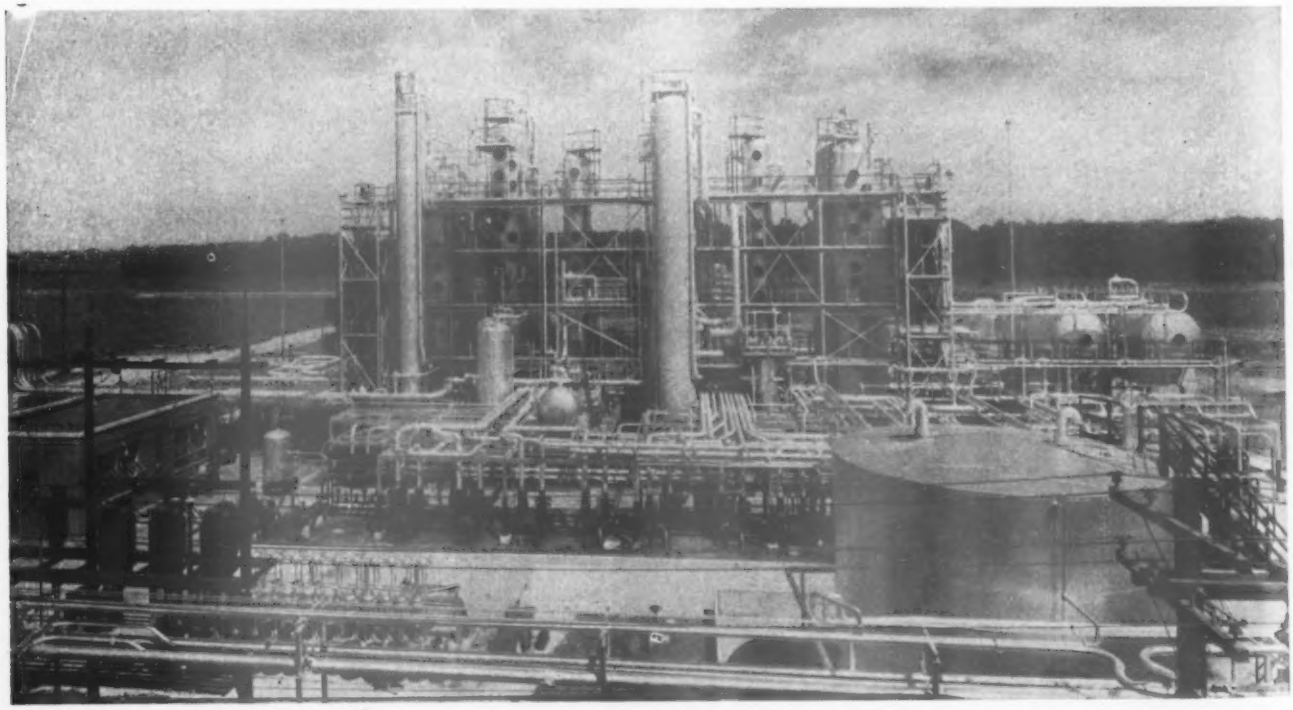
Water is injected, as has been explained, to free the extract phase of any "good" oil which is undesirable to reject with extract. The use of water in this manner results in higher yields of desirable raffinate oil than would otherwise be secured. Overhead vapors from the extract and raffinate strippers contain some phenol which, if discarded, would represent a serious solvent loss. To avoid this loss the equivalent of the amount of stripping steam used is charged to a phenol absorber tower where, in countercurrent contact with hot incoming charge stock, the phenol is absorbed by the oil while water vapor, containing not more than .002 to .005% phenol, is vented overhead.

The raffinate and extract oil streams represent the only other points where some unavoidable loss of phenol occurs. Since the phenol content of raffinate from commercial plants is normally .001%, and the phenol content of extract .002 to .004%, the total loss of phenol is surprisingly low.

As stated earlier, there are several efficient combinations of propane processes —with or without phenol extraction— besides their applicability, singly, as adjuncts to lube refining processes now installed. Such combinations are propane deasphalting, followed successively by propane acid-and-clay treating; propane deasphalting followed by dewaxing; and propane deasphalting followed by dewaxing and propane acid and clay treatment. Table 2 shows process yield data on a 15% East Texas reduced crude to make aviation lubricants, using tower deasphalting, phenol extraction and propane dewaxing.

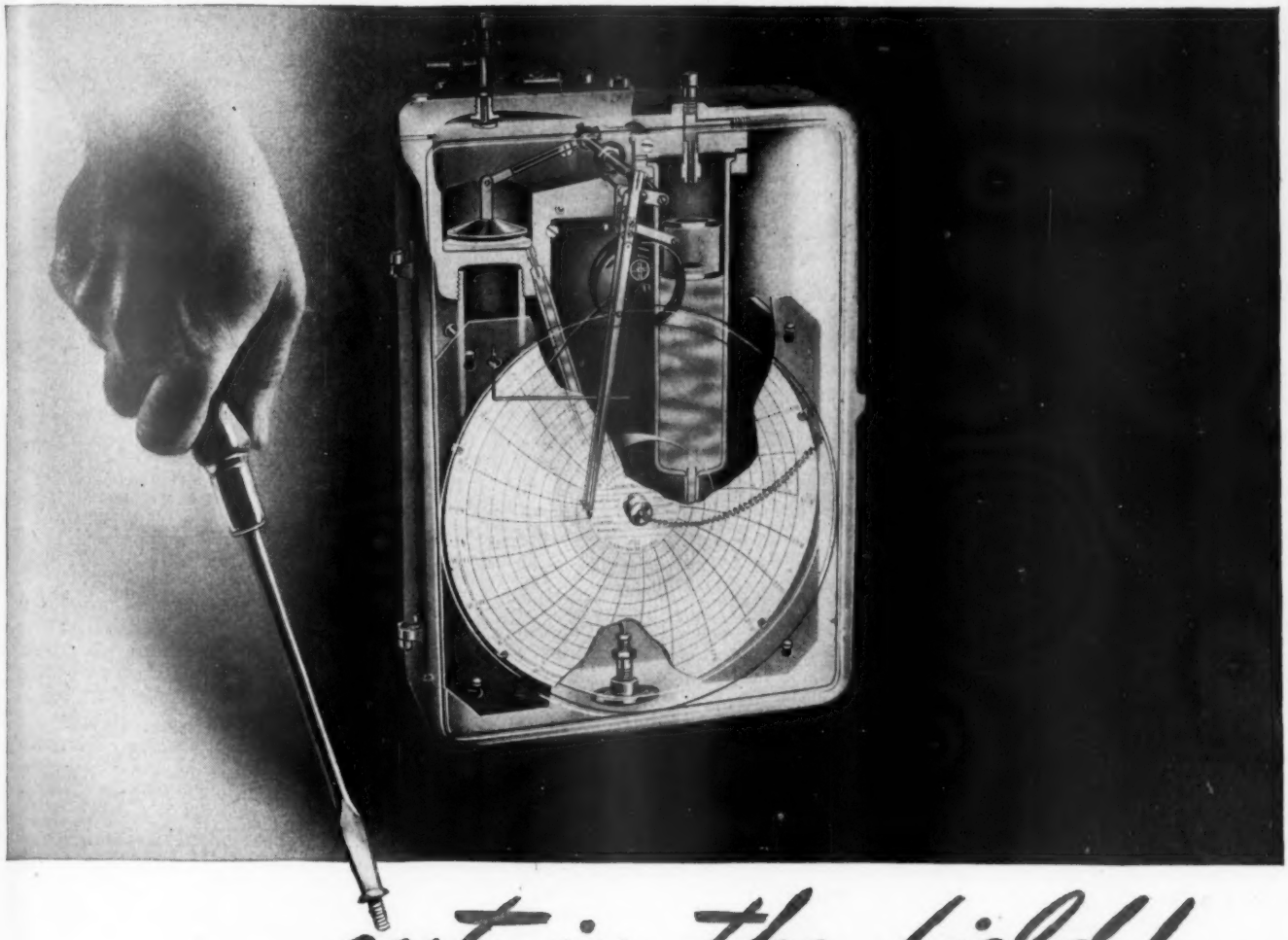
As will be noted, the charging stock represents 15% of the plant's crude charge, having a 484 SSU viscosity at 210°F with 11.1% carbon residue. Propane deasphalting permitted recovery of 10.26% of crude charge as processable oil, with only 4.74% of crude being recovered as asphalt. After phenol treating and dewaxing an oil was recovered of 4½ N.P.A. color, .26% carbon residue and zero pour test; a valuable product which otherwise would have been sold as fuel oil or perhaps made into road oil. Wax totaling 2.26% of crude charge, melting at 157°F, also was recovered. In addition, extract oil from phenol treating was available as a blending agent for road oil manufacture, as fuel oil and, in some cases, could be used as a cracking stock.

In order to select the process or processes to do a specific job, a number of



Phenol extraction unit in a Gulf Coast refinery makes high viscosity index lubes for the war effort

WHERE ACCURACY IS INSURED



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factors must be evaluated. These factors, condensed from a report of The M. W. Kellogg Co. are listed for refinery operators as follows:

(1) Are complete new lube facilities to be installed or is the new unit (or units) an addition intended to improve quality and yields or to reduce operating costs?

(2) What is: the viscosity index of the lube stock without solvent extraction; the amount of wax and asphalt to be removed; the other characteristics of the crude?

(3) What lube products are to be made, what quality—conventional or high viscosity index and what unusual specifications (if any)?

(4) What capacity in finished oil, broken down into grades and types?

(5) What base stocks are considered essential for blending purposes?

(6) How are by-products—waxes, asphalt and extract-oil—to be disposed of?

Bulk of peacetime lubricants made under normal conditions is motor oil, with average viscosity around 55-60 SSU at 210°F corresponding to SAE 20, according to this authority. Since most crudes contain too high a ratio of bright stock to neutral to blend for this viscosity, it usually is necessary to reject some potential bright stock in order to secure the desired blends.

The long residue method does not fit in with such procedure, it is claimed. So much time and money are invested in processing prior to the final split that it becomes uneconomical to dispose of the stock, except as lubricating oil, under normal operating conditions.

Usual sequence of operations in plants now under construction or on the drafting-boards employs vacuum distillation for splitting the crude into several distillates and a short reduced crude. Part or all of the reduced crude is deasphalted, followed by phenol extraction of the deasphalted oil and the several distillates. Raffinates produced subsequently are individually dewaxed and clay treated as a final step.

TABLE 3—Approximate Yields and Costs
In Processing for 1000 B/D Finished Lube Oil
(Crude Quality Intermediate Between Oklahoma City and East Texas)

Refining Operations	Processing Stock Resulting from Each Step B/D	By-Products and Losses B/D	Cost for Finished Lube, c/gal.*	Accumulated Total Processing Cost, c/gal.
Raw Crude	9200	0	0.00	0.00
Topping	2850	6350	3.00	3.00
Vacuum Distillation	2000	850**	0.34	3.34
Tower De-asphalting	1815	185	0.30	3.64
Phenol Extraction	1370	445	0.65	4.29
Propane Dewaxing	1050	340	0.91	5.20
Clay Treating	1000	50	1.00	6.20

*Excepting costs of crude and 0.5c/gal for overhead. Utility costs are assumed at 20c/1000 lbs steam, 0.5c/kwh for electricity, 2c/M gals for water, and 10c per 1,000,000 BTU for fuel. Costs also reflect minimum value of such useable by-products as wax and asphalt as well as losses of solvents and clay.

**58% of reduced crude not needed for lubes—to other refining operations—or can be processed for additional 300 bbls of bright stock.

Propane fractionation may be employed as a substitute for vacuum distillation in the preparation of raw lube cuts of SAE 30 and heavier. Propane fractionation also may be employed for preparation of special cylinder stocks and "resin" fractions of unusually high viscosity. Subsequent treatment is the same as following vacuum distillation.

Advantages of the sequence given above are summarized as follows:

(1) Amount of bright stock made is controlled at the outset.

(2) Tower deasphalting as a method of preparing stock for solvent extraction permits use of a single solvent, such as phenol.

(3) Dewaxing after solvent extraction permits reduction of the overall investment since the equipment is the most expensive of the processes per barrel of capacity both to install and operate. Finished oils of minimum pour and cloud tests are produced and by-product wax, improved by solvent extraction, thus has received the greatest enhancement in value.

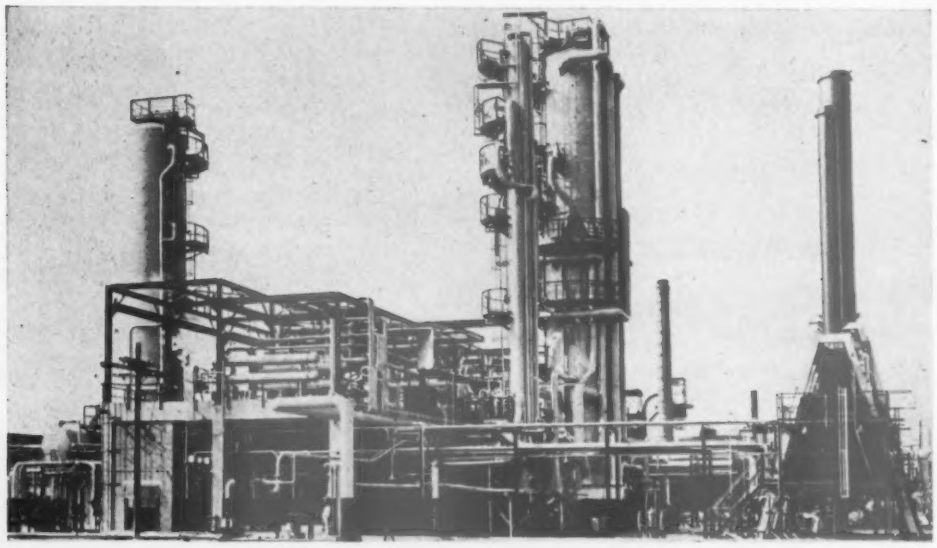
In the event it is desired to produce first and second grade oils, it is often preferable to secure the difference either by using different base stocks or to treat portions of the same stock lightly or heavily with solvent as the case requires. High viscosity index oils can be made from distillate oils by phenol treating at costs ranging from 10 to 15 cents per bbl. charged; cost of treating bright is slightly higher.

Direct Operating Costs

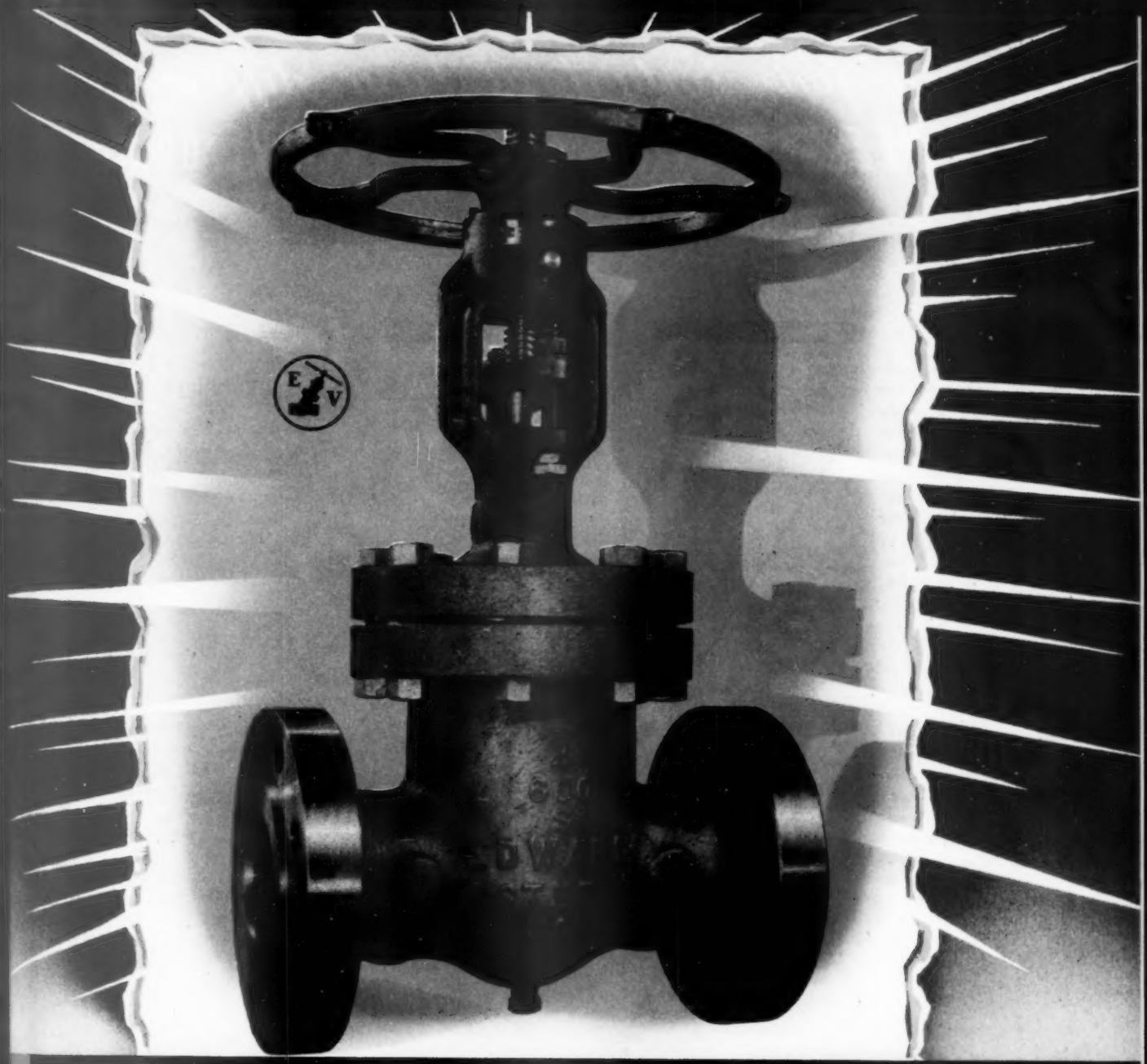
In another portion of the same report the question of direct operating costs is examined. This portion states:

"Even though the overall direct operating costs of producing high viscosity index lubes by the procedures described will vary in different refineries running different crudes, it is interesting to review the order of magnitude of such costs for what might be called average conditions.

"For example, assume the production of 1000 b/d of 95 V.I. zero pour motor oil blending stocks, to include SAE-10, SAE-30 and bright stock, in such ratio as to blend for an average viscosity of 60 SSU at 210°F. Assume utility costs of 20c per thousand pounds of steam, ½c per kwh for electricity, 2c per thousand gal of water, and 10c per million Btu for fuel. To use somewhat conservative yield figures (lower than Oklahoma City crude but higher than for East Texas crude) assume the following yields:



Phenol extraction unit of Gulf Oil Corp.'s new aviation lubricating oil plant, Port Arthur, Texas



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EAST CHICAGO, INDIANA

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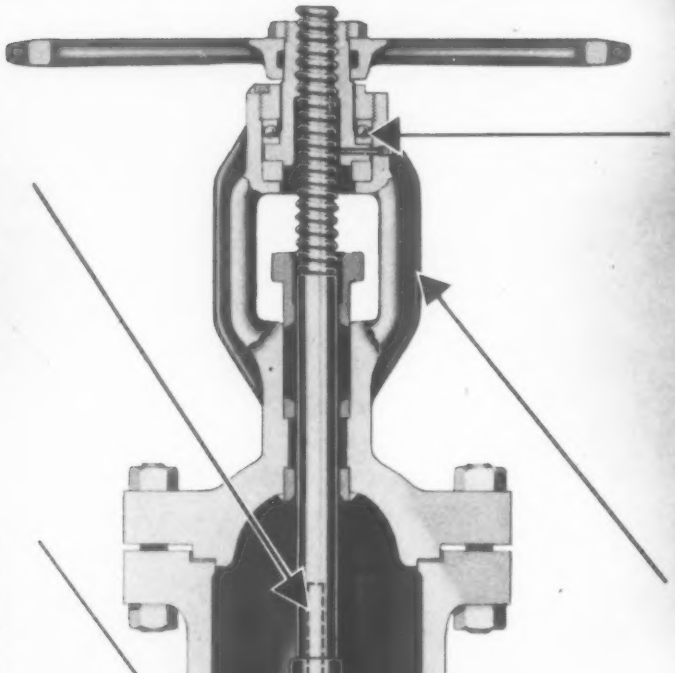
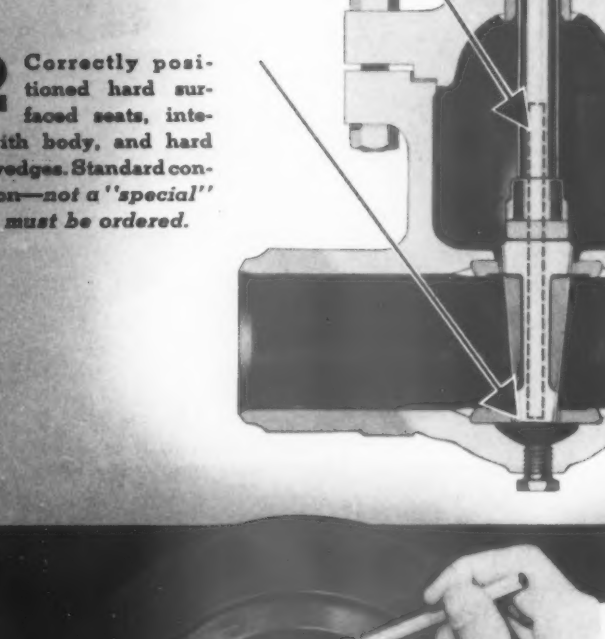
1 **Close fitting hardened wedge guides welded to body *after* seat rings and wedge are located. The result—perfect alignment of working parts and elimination of unnecessary wear-producing drag of wedge across seating faces in opening and closing valve under pressure.**

2 **Correctly positioned hard surfaced seats, integral with body, and hard faced wedges. Standard construction—*not a "special" which must be ordered.***



3 **Simple yoke construction with ball bearing operation even in medium sizes, EValized surfaces where abrasion is a problem, and no superfluous parts.**

4 **One piece bonnet for absolute alignment, easy operation and minimized maintenance.**



No wobbly wedges to cause excessive seating wear or slam against stem head when opened under pressure in Edward gate valves. In contrast with traditional gate valve design, guide ribs in Edward gate valves are accurately located with respect to seat faces and wedge, then welded integrally to body with continuous weld fillets. Clearances are thus cut to minimum and wedge can travel practically to closed position before seating faces touch.

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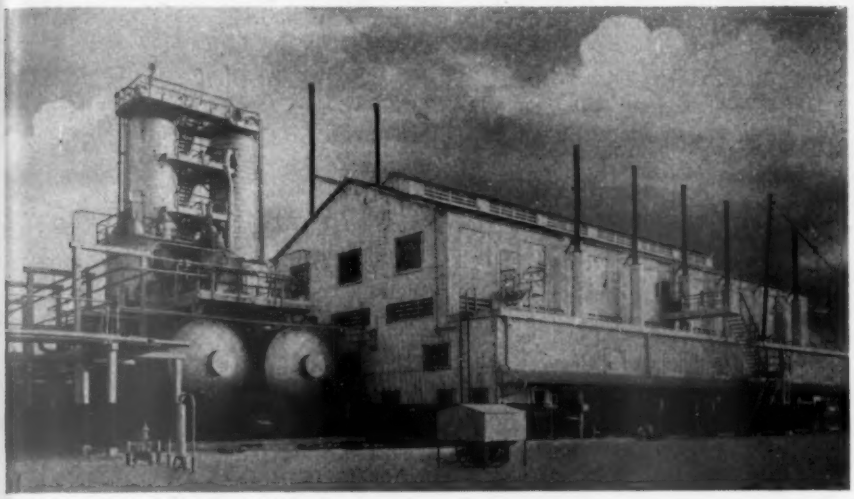

Propane dewaxing unit in a South Texas Refinery

Deasphalting . . . 70% deasphalted oil
Phenol Extraction
SAE-10 . . . . . 80% raffinate
SAE-30 . . . . . 75% raffinate
Bright stock . . . . . 70% raffinate
Dewaxing—
All Oils . . . . . 75% dewaxed oil
Clay loss 3%

"If vacuum distillation yields about 7%* of raw SAE-10 distillate, about 8%* of SAE-30 distillate, and about 16%* of short reduced crude, the crude to be processed for lubes will be about 9200 b/d. Less than one-half of the reduced crude will be required to make the bright stock necessary to give an average viscosity of 60 SSU at 210°F.

"Under these conditions (See Table 3), the overall direct operating cost (utilities, labor, maintenance, and solvent losses) for vacuum distillation, propane deasphalting, phenol extraction, and propane dewaxing will be about 2c per gallon of finished oil. Other items of expense chargeable against finished lubes will include the cost of final clay treating, the net cost of raw material after considering by-products, and some charge for general overhead.

"The method of calculating the cost of raw material and the charge for general overhead varies greatly in different refineries, and the cost of clay treating also varies with the kind and amount of clay used and method of application. The total expense for these three items should not, however, exceed 4c to 5c per gal of finished lubes. Adding this amount to the total direct operating cost figure of 2c per gal given above gives a total lube manufacturing cost (95 V.I. zero pour) of 6c to 7c per gal. . . .

"The finished oils which would be necessary to meet the assumed condition of an average viscosity of 60 SSU at 210°F., would be:

SAE-10 . . . . . 380 b/d
SAE-30 . . . . . 400 b/d
150-160 Bright Stock . . . . . 220 b/d
Total . . . . . 1,000 b/d

"In the foregoing example, the short reduced crude required to make the 220 barrels of bright stock represents only 42% of the short residue that would be produced per day from 9200 barrels of crude. Should the rest of the reduced crude be processed for bright stock, an additional 300 barrels per day of this stock would be made. And where such extra bright stock can be marketed profitably, it would be advisable to include processing capacity for handling it (the finished oils then amounting to 1300 b/d), since the incremental investment and operating costs for producing the extra bright stock would be quite low.

"But when the extra bright stock is not desired, and it is considered preferable to hold finished oil production to 1000 b/d, it would be possible to incorporate great flexibility with respect to the average finished oil viscosity. This can be achieved by installing a deasphalting unit capable of handling all of the reduced crude and by increasing slightly the phenol circulating capacity. With such provision, the amount of bright stock made could be varied from the minimum needed to meet the lowest desired average viscosity to the maximum available from the crude. This flexibility can be obtained without materially affecting overall operating cost."

*These percentages are based on crude. Interpreted on the basis of topped crude the percentages would be 23, 26 and 51 respectively.

NEW BOOKS FOR THE REFINER

Fundamental Chemistry Of Organic Compounds

Development of the fundamental chemistry of organic compounds is the main theme of the recently published text *Organic Chemistry*, by Louis F. Fieser, Professor of Organic Chemistry at Harvard University, and his wife, Mary, research chemist. Beginning with the Kekule' theory of valence and its electronic counterpart, the book proceeds from the hydrocarbons to the alcohols, acids and other derived substances.

The treatment of aromatic chemistry is somewhat more extensive than is usually found in such texts, and the chemistry of the quinones has been allotted more space than usual because of the growing importance of these substances. A useful feature of the book is the inclusion of several chapters dealing with the applications of organic chemistry to today's technology.

Although the book thoroughly covers the fundamental principles of organic chemistry, it is by no means completely elementary. As the text progresses, material of a more and more advanced nature is presented, with the empirical correlation of phenomena prevalent in the early chapters gradually giving way to interpretations in terms of modern theory and practice.

Copies of *Organic Chemistry* (6½ x 9½ in., 1091 pages, stiff cloth binding) may be obtained from the Book Department of NATIONAL PETROLEUM NEWS, 1213 West Third St., Cleveland 13, for $8.00.

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A.P.I. Issues Two Books On Production Technology

Publication of two new books on petroleum production technology has been announced by the American Petroleum Institute.

One, *Fundamental Research on Occurrence and Recovery of Petroleum* (1943), is the first of a series of annual publications containing all papers relating to the Institute's program of fundamental research on occurrence and recovery of petroleum.

The second publication, *Criteria for Determining Oil Fields' Susceptibility to Secondary-Recovery Methods*, sponsored by the Institute's standing subcommittee on Secondary-Recovery Methods is a supplement to "Secondary Recovery of Oil in the United States," a book published by the Institute in 1942.

The book on fundamental research (clothbound) is $3.50, and the supplement on secondary recovery (paper-covered) is $1.00, postpaid within the United States—both 8 x 10½ in. Orders should be sent to the American Petroleum Institute, 50 West 50th street, New York 20.

Butane Dehydrogenation By the Houdry Process*

*By R. C. Lassiat** and F. D. Parker****

The adaptation of the Houdry fixed bed catalytic cracking process to the dehydrogenation of butane is described. The process is being used commercially in the production of butadiene in the synthetic rubber program. Dehydrogenation is accomplished by passing preheated hydrocarbon vapors over catalysts of the chromic oxide alumina type, at around 1100°F. and at reduced pressures. The butane-butene cut remaining after the reaction is recycled.

In this process the Houdry reactors utilize the adiabatic principle of storing heat produced in the regeneration cycle in an inert material mixed with the catalyst and releasing the stored heat to the reacting hydrocarbons in the hydrogenation period. Yields of butadiene of around 12% per pass are reported.

A satisfactory two-stage operation of the process is also said to have been developed. Wider possibilities for the post-war refining industry are seen in the Houdry adiabatic catalytic dehydrogenation process for the conversion of paraffins, from ethane through pentane, to their olefins and diolefins as materials for petrochemical products.

THE dehydrogenation of light hydrocarbons has attracted considerable attention in recent years as a means for making the large quantities of natural gas constituents available for manufacture of petroleum constituents, chemicals, and chemical intermediates. At the beginning of the present war, major interest was focused on the production of butadiene, the principal constituent of Buna-S synthetic rubber. Buna-S rubber production represents approximately 83% of the total planned U. S. synthetic rubber production[11].

Previous Work

The literature contains numerous references to theoretical and laboratory studies of dehydrogenation yields, operating conditions, and catalysts[6, 8, 10]. It has been known for a number of years that normal butane can be dehydrogenated to butylene and butadiene at elevated temperatures in the presence of metallic oxide catalysts. One of the catalysts which is most attractive from the point of view of cost, activity, and ruggedness is chromic oxide supported on alumina[1, 2, 3, 9]. While the literature indicates that attractive yields are obtainable with this catalyst, the details of catalyst manufacture, operating conditions, heat balances, process and mechanical features of the equipment in which the reaction can be carried out commercially had to be developed by technical groups active in the field[4, 5, 7].

The basic chemistry of the dehydrogenation reaction is briefly illustrated below:

$$n\text{-}C_4H_{10} \rightleftarrows n\text{-}C_4H_8 + H_2$$
(normal butane) (normal butylene + hydrogen)

$$n\text{-}C_4H_8 \rightleftarrows C_4H_6 + H_2$$
(normal butylene) (butadiene + hydrogen)

The above reactions occur to an appreciable extent only at temperatures above 900°F.

Table I presents equilibrium values for mol. fraction of *n*-butane, butene-1, and butadiene-1, 3 as calculated from thermodynamic considerations by Gruse and Stevens[6].

Table II lists equilibrium olefin concentrations as calculated from data of Gruse and Stevens[6], Kassel, and Pitzer. The work of the latter authors on this subject is summarized by Grosse and Ipatieff[4]. While the absolute values of equilibrium constants are at variance, the magnitude of per-pass conversions is indicated.

Dehydrogenation is accomplished by passing the preheated hydrocarbon vapors under controlled conditions of space velocity, temperature, and pressure over catalysts of the chromic oxide (Cr_2O_3)-alumina type. A study of their catalytic behavior as related to their physical and chemical characteristics has resulted in the preparation of materials of controlled and highly selective activity suitable for various dehydrogenation charging stocks described in this paper.

The Houdry Adiabatic Dehydrogenation Process

During the reaction period a large amount of heat is absorbed due to the heat of reaction which is of the order of 1,000 Btu's per pound of butene produced from butane, 2,000 Btu's per pound of butadiene produced from butane. In addition to products of dehydrogenation, fixed gas is liberated and coke is deposited on the catalyst. This coke has to be burned off periodically in order to restore the initial catalyst activity.

The characteristic feature of the Houdry dehydrogenation process is that the operating conditions are so chosen that the heat used for the reaction during the on-stream period is substantially the same as the heat developed by the combustion of the coke deposit. Furthermore, the heat capacity of the catalyst bed is controlled by mixing with the active catalyst in the form of pellets, a catalytically inert material. Several sources of such inert material are available, but secrecy orders do not permit disclosure of further details at this time. The inert material acts as a heat storage medium absorbing during the regeneration cycle the heat liberated by the combustion of the coke deposit, with a consequent increase in temperature of the bed, and releasing that heat to the reacting hydrocarbons during the dehydrogenation period, with decreasing temperature.

The preferred condition is that the heat of reaction be slightly greater than the heat of combustion. The heat deficiency

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*Presented before the California Natural Gasoline Assn., Los Angeles, Oct. 13, 1944.

**Houdry Laboratories, Catalytic Development Corp., Linwood, Pa.

***Bechtel-McCone Corp., Los Angeles.

TABLE I—N-Butane Dehydrogenation Equilibrium [a]

Temperature			Equilibrium Mol Fraction							
			n-butane		butene-1		butadiene-1, 3		hydrogen	
°K	°C	°F	1 atm.	0.25 atm.	1 atm.	0.25 atm.	1 atm.	0.25 atm.	1 atm.	0.25 atm.
600	327	621	.97	.96	.015	.02			.015	.02
700	427	801	.72	.58	.14	.20		.01	.14	.21
800	527	981	.42	.20(b)	.27	.34	.01	.04	.30	.42
900	627	1,161	.20	.02	.29	.30	.07	.13	.44	.55
1,000	727	1,341	.01	.01	.22	.09	.18	.27	.59	.63

(a) "Rounded off" values from Gruse and Stevens
(b) Adjusted

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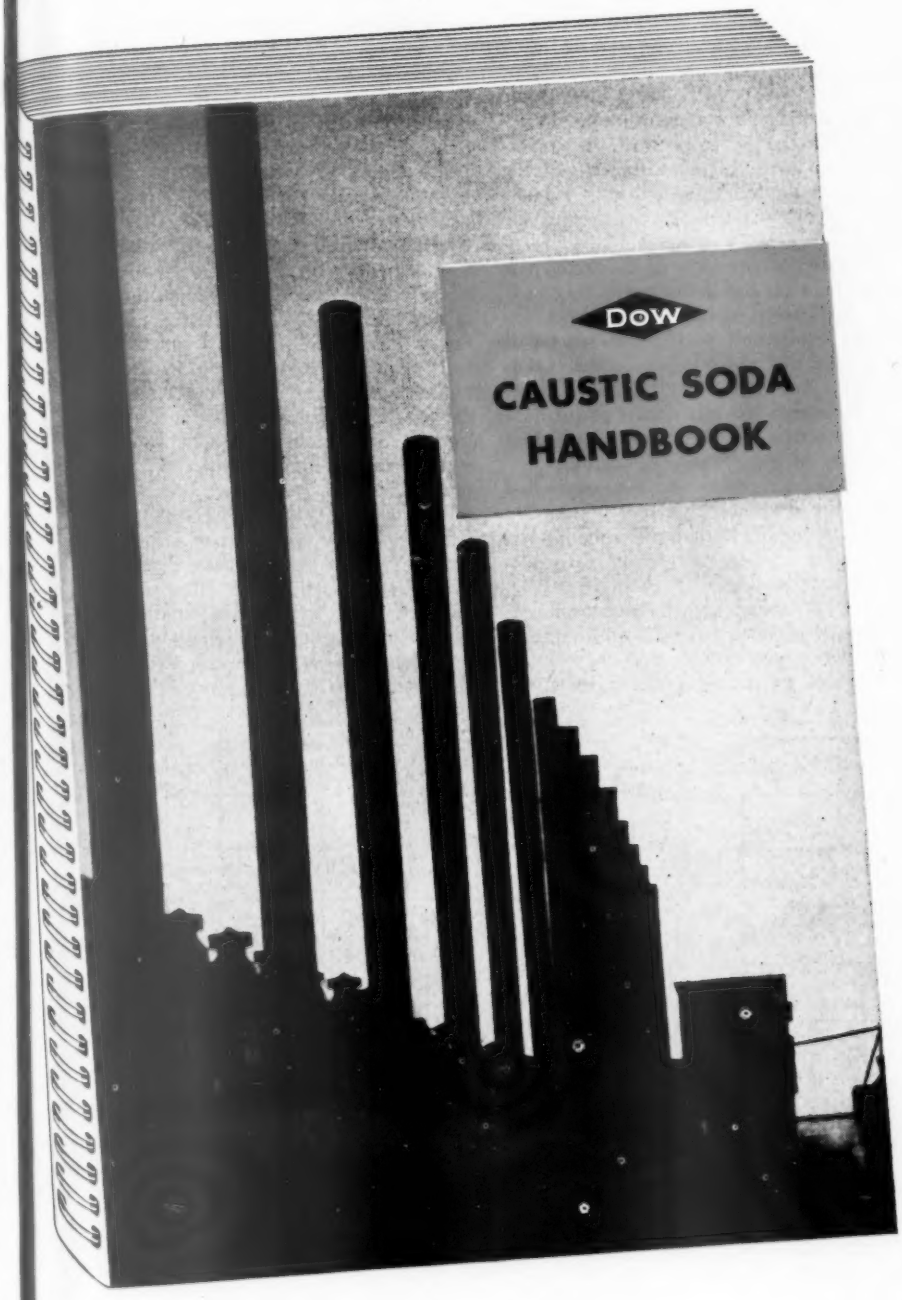

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TABLE II—Comparison of Calculated Equilibrium Olefin Concentrations In Butane Dehydrogenation at Atmospheric Pressure

Temperature			Equilibrium Olefin Concentration (Mol %)		
°K	°C	°F	Gruse and Stevens[a]	Kassel[b] [c]	Pitzer[b] [c]
700	427	801	14	8.3	11.4
773	500	932	25	20.6	24.5
873	600	1,112	34	40.3	41.9
1,000	727	1,341	40	48.7	48.7

[a] Includes butene and butadiene.
[b] Butene only.
[c] Reported by Grosse and Ipatieff.

and the desired operating temperature are controlled by the adjustment of reactant and air temperatures, and by the use in the regeneration cycle of an amount of air substantially greater than the combustion requirements. The latter equalizes differences in temperature in a large size bed due to heat losses in parts adjacent to the wall, imperfect flow distribution of fluids throughout the bed, minor inequalities in catalyst activities and heat capacities, and the like. The air used being near atmospheric pressure, the cost of pumping is nominal and the heat can be recovered in waste heat boilers.

The inert material possesses a very large surface and the heat exchange between this material, the catalyst pellets, and the reactants takes place with very small temperature differences.

The on-stream periods are kept very short, namely, between 7 and 15 minutes. By this means the temperature variation during the cycle is small, usually within 50°F. covering the optimum range of temperature necessary to insure high conversions; also the total coke deposit on the catalyst is limited to a low value, insuring high catalyst activity throughout the cycle.

The advantages derived from the use of this scheme are as follows:

1. Expensive special alloy heat exchange equipment within the reactor is eliminated and the reactor construction is cheap.

2. Reactants are introduced at substantially reaction temperature, eliminating problems of pre-thermal cracking.

3. The temperatures are controlled within the desired range of reaction. No excessive temperatures are encountered during the regeneration period, thus protecting catalyst life.

4. Regeneration can be accomplished by the use of fresh air, with no limitation of oxygen concentration, and there is no problem of recirculating hot gases.

5. High conversion per pass and high product concentration are feasible.

Extensive laboratory and pilot plant experimentation as well as continuous commercial operation have proved the practicability of this unique development.

Effect of Variables

Temperature — Dehydrogenation equilibria referred to previously indicate that high temperatures are required for conversions of commercial interest. These equilibria are such that mono-olefins can be produced economically at substantially atmospheric pressure and temperatures of the order of 1050-1100°F. For the production of di-olefins, however, not only high temperatures but also low partial pressures are necessary. These can be attained by either diluting the reactants with some inert gas or vapor or operating at low absolute pressure. Considerations of cost usually preclude the use of gases. Steam has been found to be detrimental to the reaction, as well as to catalyst life. Operating at reduced pressures as low as 2½ lbs. absolute has been found practical for the production of di-olefins and the engineering problems connected with this type of operation have been readily solved.

Fig. 1 shows the effect of temperature at various space rates on the dehydrogenation of butane. These data were obtained during the study of butadiene production and were, therefore, obtained at reduced pressure. Of interest is the rapid increase of yield with temperature, the

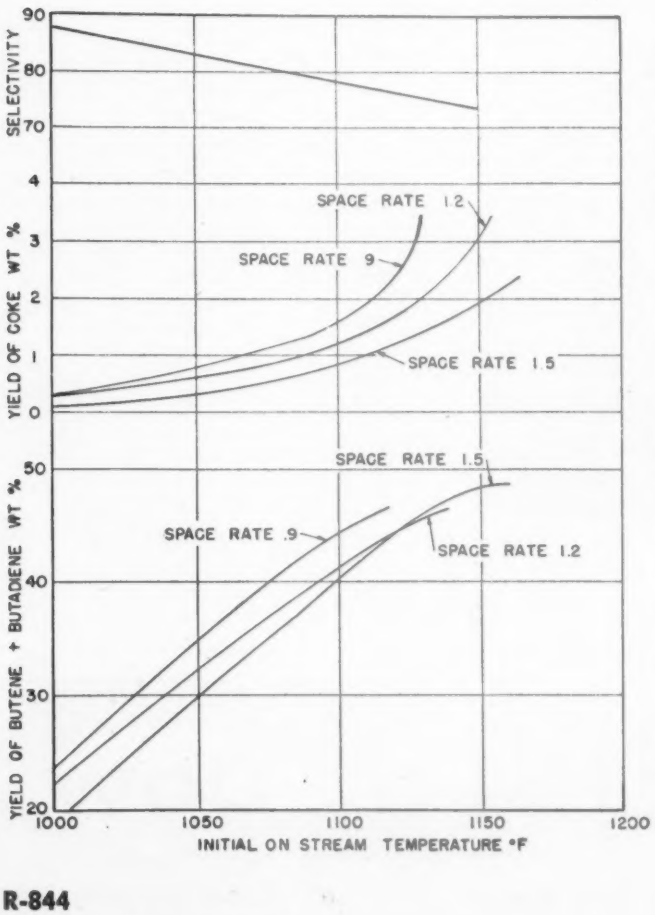


Fig. 1 left—Effect of temperature on the dehydrogenation of n-butane; pressure, 7 in. Hg abs

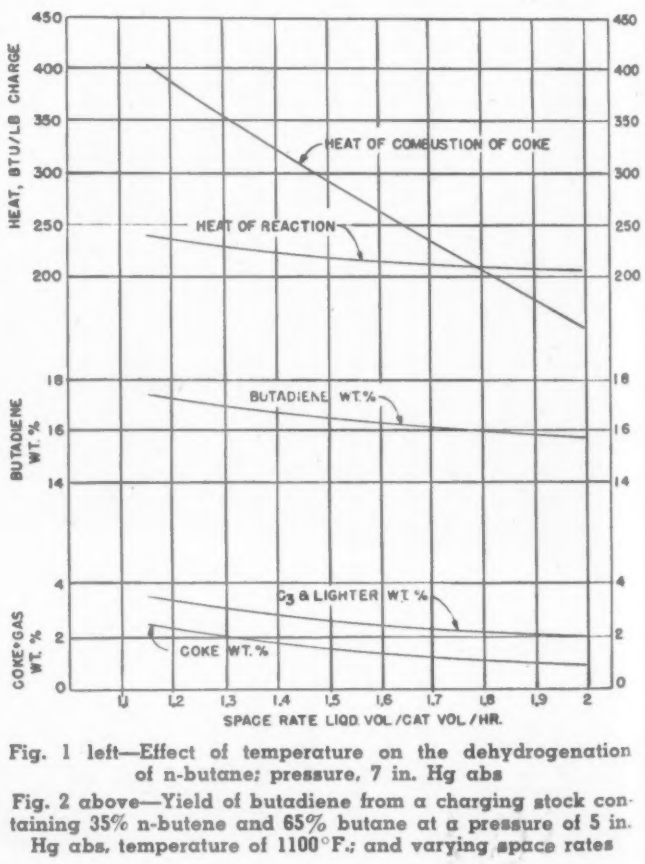


Fig. 2 above—Yield of butadiene from a charging stock containing 35% n-butene and 65% butane at a pressure of 5 in. Hg abs, temperature of 1100°F.; and varying space rates

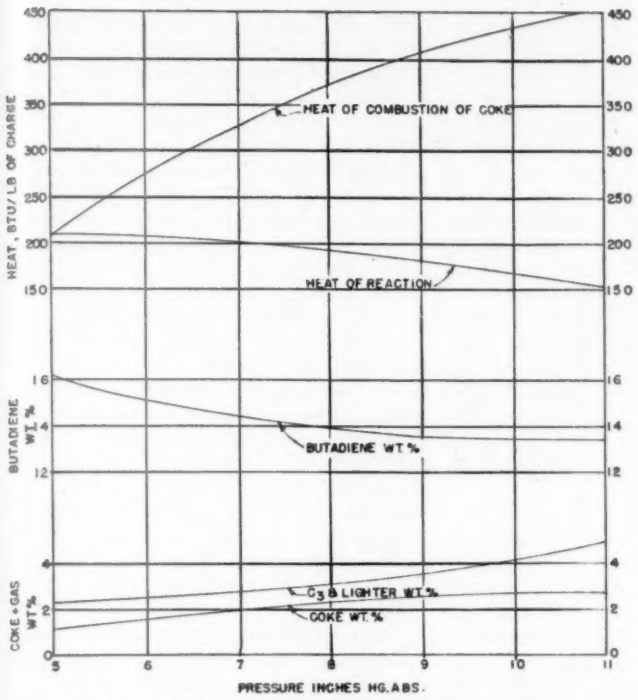


Fig. 3 above—Effect of varying pressure at constant temperature, 1100°F., and constant space rate, 1.8 vol/vol/hr., on a 35% n-butene and 65% n-butane charging stock

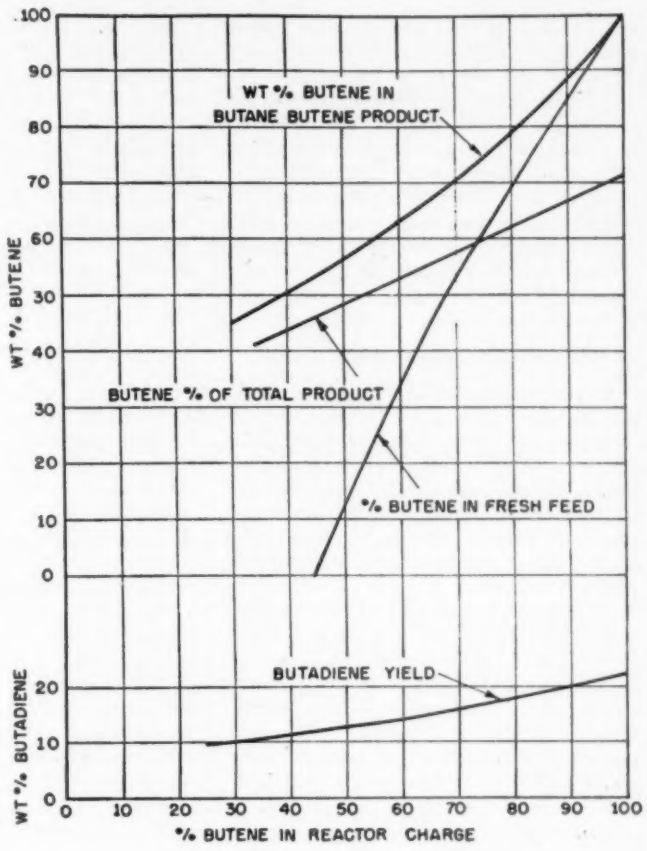

WT % BUTENE IN BUTANE BUTENE PRODUCT
BUTENE % OF TOTAL PRODUCT
% BUTENE IN FRESH FEED
BUTADIENE YIELD
WT % BUTENE
WT % BUTADIENE
% BUTENE IN REACTOR CHARGE

Fig. 4 right—Relationship between butene in original fresh feed, butene in composite feed to reactor, butene in recycle stock and butadiene in reactor product. Temperature 1100° F.; space rate, 1; pressure, 5 in. Hg abs

decrease in selectivity, and the rapid increase in coke formation above 1100°F.

Space Rate—Space rate can be varied quite widely without substantially affecting the yield of products. The side reactions, particularly the coke formation, are cut considerably by increased space rates and this factor is the most effective way to balance out heat of reaction with heat of carbon combustion.

Fig. 2 shows the yield of butadiene from a charging stock containing 35% *n*-butene and 65% butane at constant pressure, constant temperature, and varying space rates.

The upper curves show the calculated heat of reaction and heat of combustion, respectively. The point at which the curves cross is the point of operation at "adiabatic condition."

These data were obtained in a laboratory isothermal unit.

Pressure—Within the range of pressures necessary to effect the desired reaction an adjustment in pressure also provide means of controlling the coke deposit in relation to the heat of reaction.

Fig. 3 shows the effect of varying pressure at constant temperature and space rate on same charging stock as above, i.e. 35% *n*-butene and 65% *n*-butane.

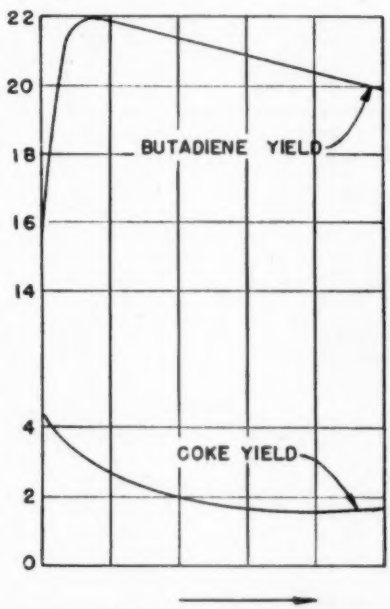
Again it can be seen that the curves showing heat of reaction and heat of combustion cross at the operating point for the chosen space rate and temperature.

Feed Composition—Fig. 4 shows the relationship between butene in original fresh feed, butene in composite feed to reactor, butene in recycle stock, and butadiene in reactor product.

It shows the yields of products from once-through operation (lower scale) and the yield and product distribution in recycling operations.

For example, starting with *n*-butane (0% butene in fresh feed), the reactor charge builds up to approximately 44% butene and the yield of butadiene per pass is 12.5%.

Catalyst Activity—From the above considerations, it is evident that the catalyst



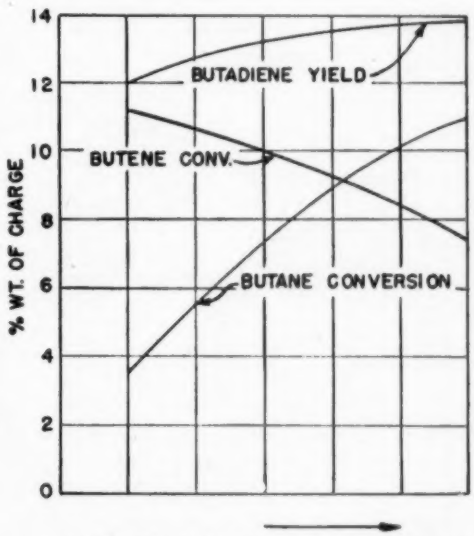


Fig. 5—Effect of catalyst activity

must possess enough activity to give good conversion with a controlled coke deposit. Also, the activity must be oriented towards the maximum conversion of butane resulting in higher butene concentration in reactor charge and subsequently higher conversions to butadiene per pass.

Fig. 5 shows the effect of catalyst heat treatment on butadiene and coke yield for a given concentration of chromic oxide on the alumina support and the effect of varying this concentration on conversions of butane and butene, respectively.

Description of Commercial Units

Fig. 6 is a simplified flow chart of the single-stage unit.

The normal butane is preheated in a furnace along with the unconverted butane-butene cut recycled from the extraction unit. The catalytic battery comprises 6 reactors, although it could be built with 3 reactors of same total capacity.

After passing through the catalyst bed, the hydrocarbons are cooled by direct spraying with oil, compressed and sent to a vapor recovery system of conventional design where a cut of butadiene-butene-butane is obtained. Butadiene is extracted and purified by solvent or a combination distillation-solvent extraction, the remaining B-B cut returned to the process as recycle stock.

After the on-stream period, air is introduced to burn off the coke deposit. This air is preheated by direct combustion of fuel in the stream, and the pressure at the blower discharge is controlled by the pressure drop through the system which is generally of the order of 2-3 psi.

At the end of the regeneration period, the air remaining in the reactor is evacuated by a steam jet, prior to introduction of hydrocarbons for another on-stream period.

Motor operated valves are operated through a cycle timer similar to the type used in a large number of Houdry catalytic cracking units. Proper interlocks insure that a valve cannot be opened unless the necessary valves have been previously closed, precluding mixing of various streams.

As a further precaution against mixing of streams through valve leakage, inert gas is automatically admitted in the bonnets and lantern rings provided in the packings when valves are closed.

The flow of reactants and air is continuous, two reactors of the battery receiving hydrocarbons while two are receiving air, and the last two being under valve change or purging operation.

Heat can be recovered from the cooling oil by heat exchange with the furnace feed and from the air stream in waste heat boilers.

A very satisfactory two-stage operation has also been developed. Secrecy restrictions imposed by government agencies preclude discussion of the details of operation at the present time.

Commercial operation of the Houdry adiabatic catalytic dehydrogenation process is carried on by the Sun Oil Co. at their Toledo refinery and the Standard Oil Co. of California at their El Segundo refinery. Both of these facilities were built by Defense Plant Corp., and are operated by the respective oil companies for the account of the Rubber Reserve Co. Butadiene production from the Toledo plant is utilized in the production of GR-S rubber at the copolymerization plants of Firestone and Goodyear at Akron. Butadiene from the El Segundo installation is utilized at the U. S. Rubber and Goodyear plants at Torrance, Cal. One of these plants operates in the single-stage cycle as described above. The other plant is equipped to operate either single or two-stage.

Table III gives a comparison of typical pilot plant, semi-commercial plant, and commercial plant operating conditions and yields.

Commercial results are in general agreement with the correlation of Fig. 4, with certain deviations as regards butene concentration in the reactor charge, although butadiene yields per pass pre-

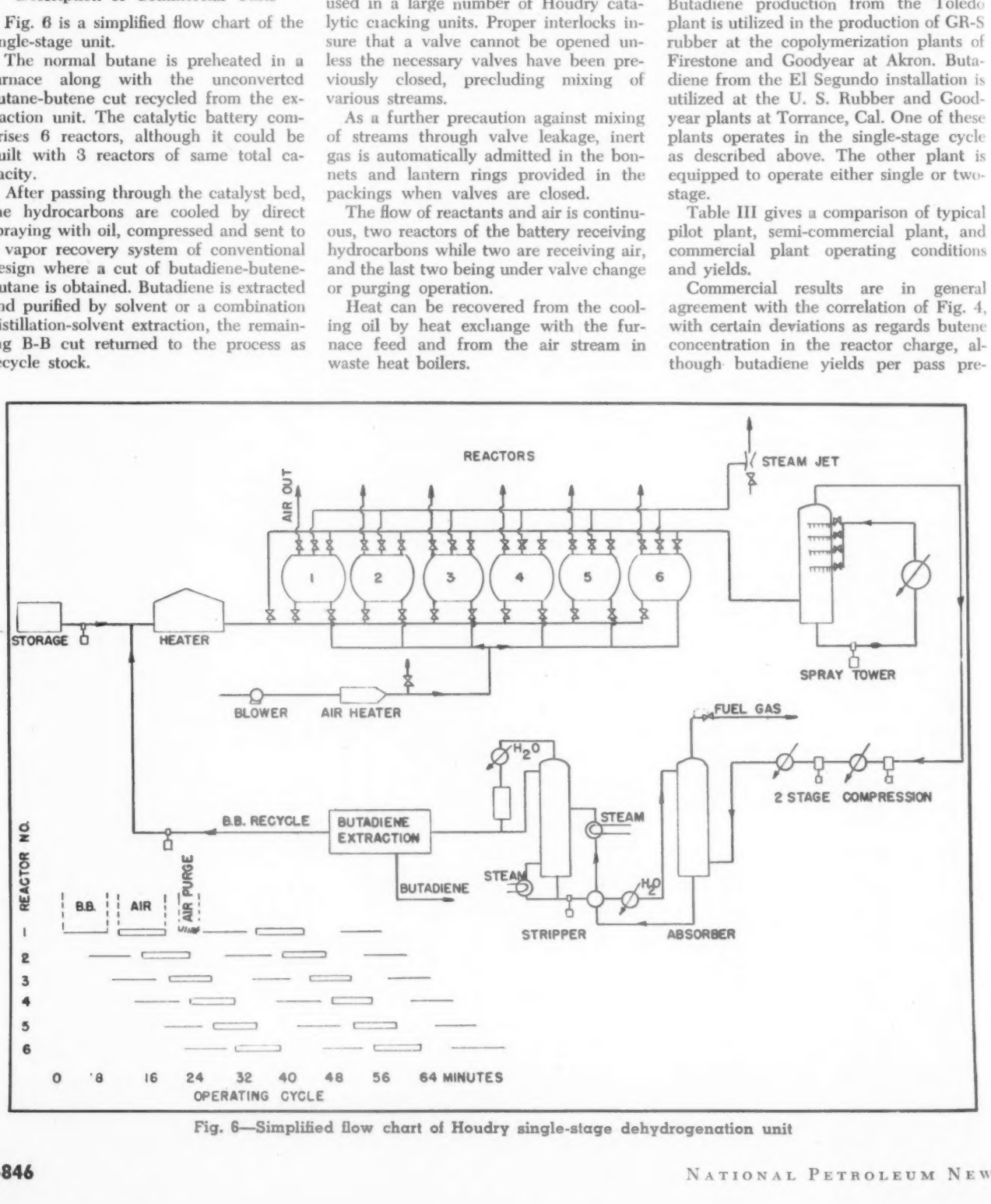


Fig. 6—Simplified flow chart of Houdry single-stage dehydrogenation unit

TABLE III—Comparison of Laboratory, Semi-Commercial and Commercial Units, Houdry Single-Stage Butadiene Process

Unit	Pilot Plant		Semi-Commercial		Commercial	
Catalyst Capacity, cu. ft.	0.35		11.7		1,060	
Number Cases	1		1		6	
Operating Conditions						
Cat. Temp., on-stream, °F. ave.	1,060		1,124		1,100	
Cat. Temp., off-stream, °F. ave.	....		1,083		....	
Cat. Temp., °F. ave.	....		1,103		1,070	
Pressure, inches Hg. Abs.	5.0		4.9		4.9	
Time on-stream, Mins.	10.0		7		10	
Charge Temperature, °F.	....		1,085		1,075	
Regeneration Air Temp., °F.	....		1,140		1,075	
Charge Rate, V/V/Hr.	1.9		2.8		2.7	
Regeneration Air Rate, CFM/Liter	0.5		1.8		2.2	
Yields, % Wt.	**Chg.**	**Prod.**	**Chg.**	**Prod.**	**Chg.**	**Prod.**
C_4 and Lighter	...	1.6	4.6	7.8	2.2	3.7
Isobutane	2.5	3.7	3.1	1.6	0.9	1.9
Isobutene		3.5	1.5	0.3	0.1	2.5
n-Butene	26.8	36.8	28.9	26.9	23.1	23.1
n-Butane	70.5	49.9	62.7	46.3	67.0	53.3
Butadiene	0.2	10.1	...	11.8	3.8	12.7
C_5 Plus	...	0.4	...	0.8	0.9	1.7
Coke	...	1.0	...	2.5	...	1.2
	100.0	100.0	100.0	100.0	100.0	100.0

dicted in the correlation are obtained.

For the production of butenes from the corresponding normal and isobutane, the reaction is conducted at atmospheric or slight positive pressures and the space rate adjusted to balance the coke formation with the necessary heat of reaction.

Laboratory and semi-commercial operations have indicated the possibility of obtaining up to 50% conversion with selectivities of the order of 70 to 75%.

The plant flow sheet is substantially the same as the one-stage unit. Line sizes and compression recovery facilities are smaller than with vacuum operation.

If it is desired to produce both butadiene and butenes, the process can be operated under reduced pressure. In this case it is more practical to balance the heat requirements by supplementing the normal coke production. This can be accomplished by passing on the catalyst a nominal amount of an extraneous material heavier in boiling range than the charge, after the dehydrogenation period.

Propane and ethane can be dehydrogenated to their corresponding monoolefins. The equilibrium concentrations in the same temperature region are lower than for the dehydrogenation of butane. Consequently, the yields per pass are correspondingly lower, of the order of 30% for propene and 16-20% for ethylene. The selectivities are high and the coke formation low at atmospheric pressure, and means of supplementing the coke formation as described above are used.

In order to obtain ultimate yields, it is necessary to provide means for selectively removing the ethylene or propylene, as the case may be, from the reactor effluent after quenching and recovery by compression and/or absorption. As is well-known, the ethylene can be removed by sulfuric acid and synthetic ethyl alcohol produced by hydrolysis. Propylene can be similarly removed to form isopropyl alcohol on subsequent hydrolysis. It is therefore seen that a whole field of potential chemical industries is opened up by catalytic dehydrogenation of the relatively inert paraffin constituents of natural gas and gasoline to olefins or di-olefins, which can be reacted in a number of ways to produce a large number of products. Fig. 7, from Bureau of Mines Information Circular 7108, diagrammatically shows a few of the intermediates and chemicals which can be produced from paraffinic hydrocarbons through the initial step of dehydrogenation.

Other Applications

Among the other products which have received attention in laboratory scale experimentation are:

Isoprene from dehydrogenation of isopentane.

Styrene from ethyl benzene.

Methyl styrene from isopropyl benzene.

These reactions, not being limited by the low equilibrium concentration of the lower olefins, take place readily in the range of 1,000-1,050°F., and yields per pass of the order of 45% styrene and 60-65% methyl styrene are obtained.

The principle of storing regeneration heat in an inert high heat capacity medium in the catalyst bed has still another interesting application in the Houdry adiabatic catalytic cracking process for the conversion of heavy petroleum fractions to gasoline.

Conclusion

In conclusion, it may be stated that the Houdry adiabatic catalytic dehydrogenation process has made available to the petroleum refining, petrochemical and natural gasoline industries a means for converting paraffins from ethane through pentane to olefins and di-olefins. Other dehydrogenation reactions of commercial interest can be handled by the process. Commercial operation of the Houdry adiabatic dehydrogenation process for the production of butadiene proves the feasibility of the process. Large potentialities for production of chemicals from petroleum are opened up and it is therefore expected that the process will find application in postwar dehydrogenation projects.

Acknowledgment

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Sun Oil Co.

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TECHNICAL MEETINGS FOR OIL MEN

DECEMBER

8, American Standards Association, New York City.

JANUARY, 1945

8-12, Society of Automotive Engineers, annual meeting and engineering display, Book-Cadillac Hotel, Detroit.

17, American Society for Testing Materials, New York District—"Petroleum and Some of Its Modern Derivatives", Engineering Societies Bldg., New York City.

FEBRUARY

28, American Society for Testing Materials—Spring Meeting, Hotel William Penn, Pittsburgh.

MARCH

12-14, National Association of Corrosion Engineers, President Hotel, Kansas City, Mo.

MAY

16-17, Society of Automotive Engineers, Diesel Fuel and Lubricants Meeting, Hotel Carter, Cleveland.

JUNE

18-22, American Society for Testing Materials, 48th Annual Meeting, Hotel Statler, Buffalo, N. Y.

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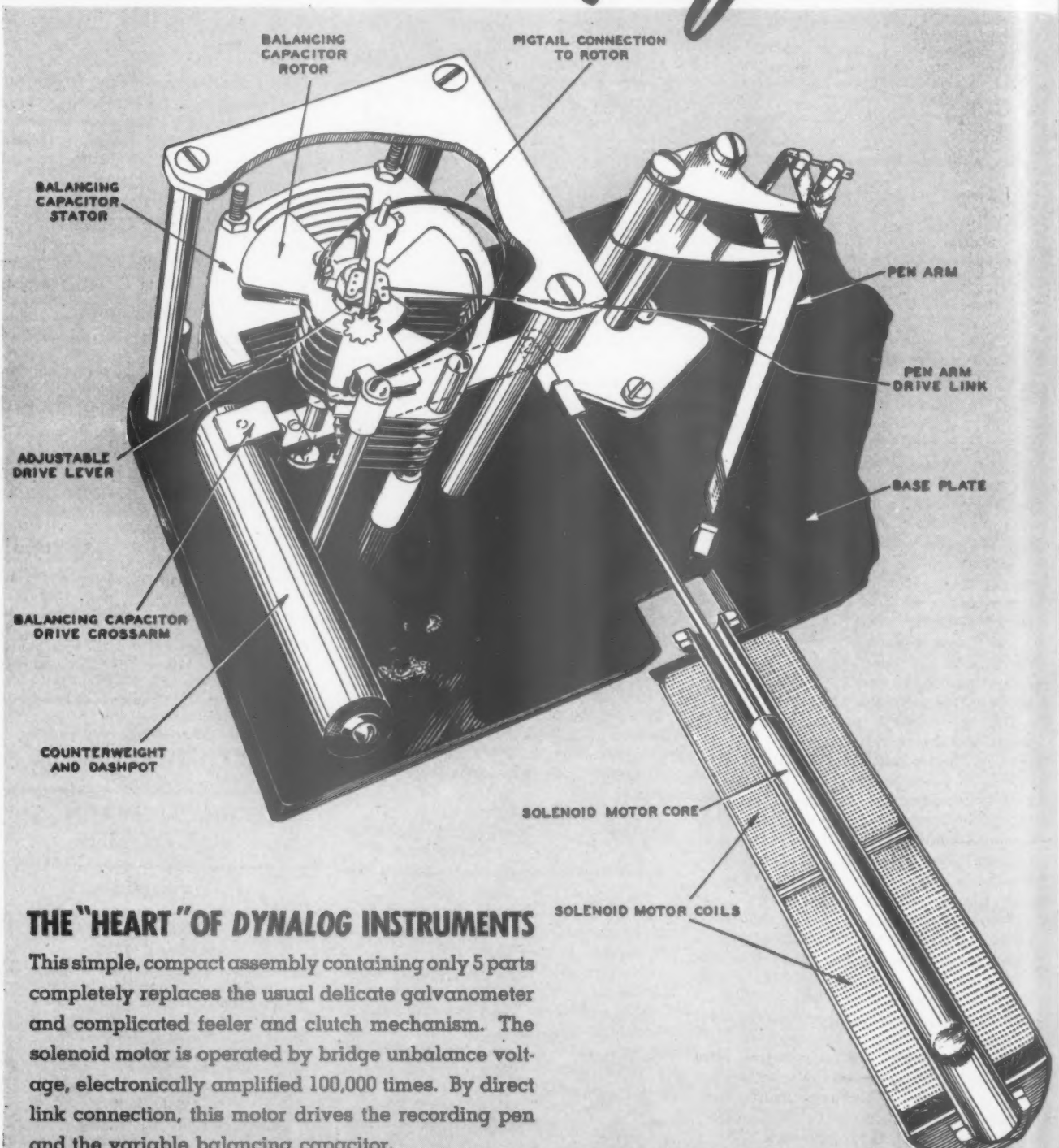

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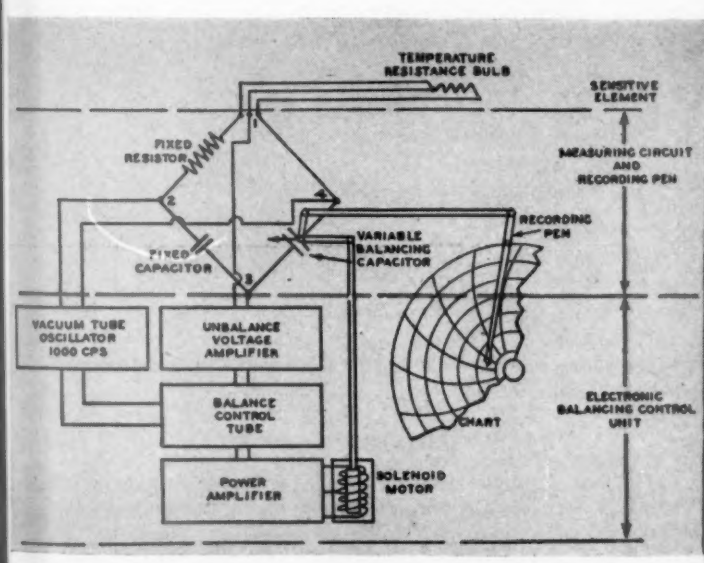

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Horizontal Tank Calibration

*By E. F. Brummerstedt**

Determining the correct calibration of a gauge pole for measuring the contents of a cylindrical tank which is in a horizontal position is often a time-consuming job, involving as it does the use of complicated mathematics.

In this article a simplified mathematical formula for calculating the contents of such a tank at any depth is developed. The author goes one step further, then, and uses his simplified formula to plot a generalized calibration curve, which can be used for any horizontal cylindrical tank by adjusting what he terms "Volumetric Coefficients" for the proper length and diameter. Although developed specifically for tanks with 2:1 ellipsoidal heads, the curve can also be used for tanks with either flat or spherical heads.

Refinery engineers often ask for a curve which can be used to calibrate gauge poles for horizontal cylindrical storage tanks furnished on refinery contracts. Such a curve can be quickly drawn up for any tank of given diameter, length, and shape of heads, based on a mathematical calibration equation developed from fundamentals of trigonometry, analytic geometry and integral calculus.

The calibration equation must give the volume of a given tank for any desired depth measured from the bottom of the tank. This implies that the tank be truly horizontal, i.e., have no slope. In actual practice horizontal tanks often have a very slight slope of approximately ¾ inch per 10 feet of length, in order to allow complete drainage at the lower end. This slope must be disregarded in any mathematical calibration equation. Its effect can be eliminated entirely if the gauge poles are read at the middle of the straight length of the shell, so that the mean depth can be read. There will be a slight error at the extreme readings on the poles, but this will not exceed 1% in most cases. Reading the poles at either end of the tank, of course, will introduce a somewhat greater percentage of error, if the tank is not horizontal.

Cylindrical Section

All tanks consist of a straight shell or cylinder of given length, and of two heads, which may be of various shapes but are usually semi-ellipsoidal. If the heads are flat, as may be the case if the tanks are small and under no pressure, the development of the calibration equation is quite simple, being confined to the cylindrical sections only. This equation was developed in a previous publication(1), but will be repeated here for the sake of completeness.

Referring to Fig. 1, the volume, dV, of an infinitesimal layer of liquid of thickness dy can be expressed by the equation

$$dV = 2Lx\,dy$$

where

L = length of cylinder, and
x = one-half width of layer.

The volume of liquid to any depth y may be found by the summation of all such infinitesimal layers between the depths of 0 and y, or, as expressed in integral calculus,

$$V = 2L\int_0^y x\,dy \qquad (1)$$

The equation of the circle with the origin of coordinates at the end of the y-axis, instead of at the center, is, from analytic geometry,

$$x^2 + y^2 = 2Ry$$

and hence

$$\sqrt{2Ry - y^2} \qquad (2)$$

Substituting this value of x in Equation (1),

$$V = 2L\int_0^y \sqrt{2Ry - y^2}\,dy$$

From a table of integrals, the evaluation of the above integral becomes

$$V = L\left[(y-R)\sqrt{2Ry-y^2} + R^2 \text{ vers}^{-1}\frac{y}{R}\right]^y$$

$$= L\left[(y-R)\sqrt{2Ry-y^2} + R^2 \text{ vers}^{-1}\frac{y}{R}\right] \qquad (3)$$

where V is in cu. ft.; L, R and y are in feet, and $\text{vers}^{-1}\ y/R$ is in radians.

To check Equation (3) for the volume of the full cylinder, substitute $y = 2R$. Then

$$V = L\left[(2R-R)\sqrt{4R^2-4R^2} + R^2 \text{ vers}^{-1}\frac{2R}{R}\right]$$

or

$$V = L(R\sqrt{0} + R^2 \text{ vers}^{-1}\,2)$$

$$= LR^2 \text{ vers}^{-1}\,2$$

And since $\text{vers}^{-1}\,2 = \cos^{-1}(1-2) = 180°$ or π radians, then

$$V = LR^2\pi = \pi R^2 L$$

which is the correct equation for the volume of a cylinder of length L and radius R.

Ellipsoidal Heads

The two ellipsoidal heads of a tank together form a complete ellipsoid, with known axes a, b and c. In the present case, the

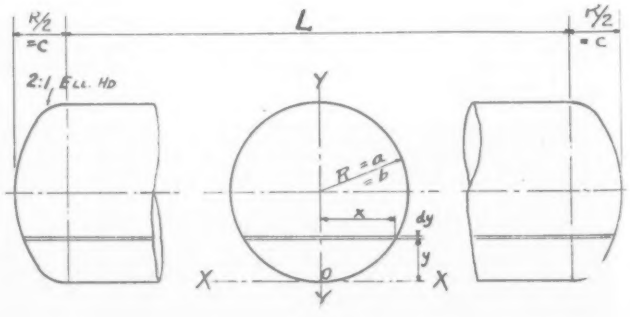

Fig. 1

(1)"Calibration of Horizontal Cylindrical Tanks," by Herndon David, *Oil & Gas Journal*, March 4, 1943.

*Petroleum Refinery Division, Foster Wheeler Corp., New York.

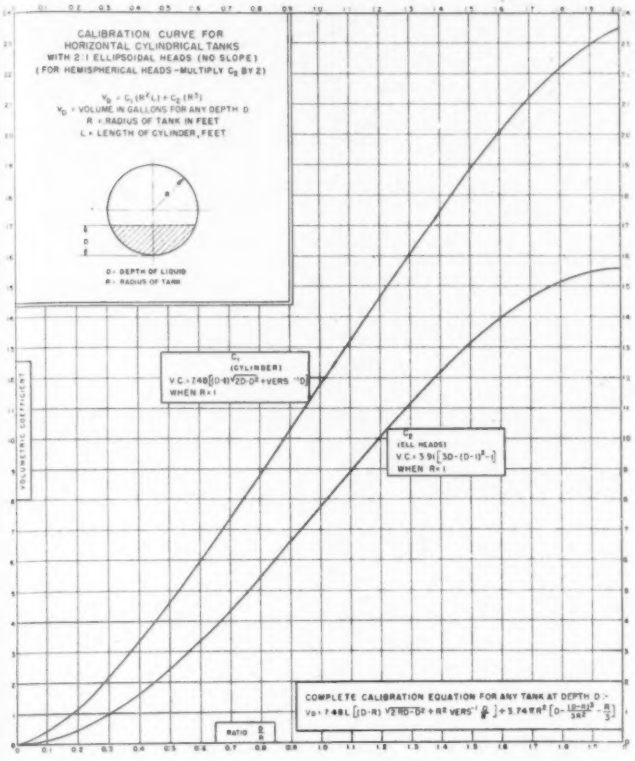
CALIBRATION CURVE FOR
HORIZONTAL CYLINDRICAL TANKS
WITH 2:1 ELLIPSOIDAL HEADS (NO SLOPE)
(FOR HEMISPHERICAL HEADS - MULTIPLY C_E BY 2)
$V_D = C_1(R^2L) + C_2(R^3)$
V_D = VOLUME IN GALLONS FOR ANY DEPTH D
R = RADIUS OF TANK IN FEET
L = LENGTH OF CYLINDER, FEET
D = DEPTH OF LIQUID
R = RADIUS OF TANK
C_1 (CYLINDER)
V.C. = 7.48[(D-R)$\sqrt{2RD-D^2}$ + VERS^{-1} ...]
WHEN R = 1
C_2 (ELL. HEADS)
V.C. = 5.91[3D-(D-1)^3-1]
WHEN R = 1
VOLUMETRIC COEFFICIENT
COMPLETE CALIBRATION EQUATION FOR ANY TANK AT DEPTH D :-
RATIO $\frac{D}{R}$

Fig. 2—Calibration curve for horizontal cylindrical tanks

two larger axes a and b are both equal to the radius of the tank, R. The smaller axis c, by definition of a 2:1 ellipsoidal head, equals $R/2$.

From analytic geometry, the equation of an ellipsoid is

$$\frac{x^2}{a^2}+\frac{(y-b)^2}{b^2}+\frac{z^2}{c^2}=1 \qquad (4)$$

wherein the origin of coordinates has been set off from the center along the y axis for a distance b, or the length of a major axis.

Now the area A_y of the elliptical cross-section at any depth y is given as

$$A_y=\pi a_x c_z$$

where

a_x = maximum axis length in the x plane, and
c_z = maximum axis length in the z plane.

From analytic geometry the equation of this cross sectional ellipse is

$$\frac{x^2}{a_x^2}+\frac{z^2}{c_z^2}=1$$

Since $a_x = 2c_z$ by definition, then

$$\frac{x^2}{4c_z^2}+\frac{z^2}{c_z^2}=1$$

or

$$\frac{x^2}{4}+z^2=c_z^2$$

and likewise

$$A_y=\pi 2c_z c_z=2\pi c_z^2$$

or

$$A_y=2\pi\left(\frac{x^2}{4}+z^2\right)=\pi\left(\frac{x^2}{2}+2z^2\right)$$

Since $x = 2z$ by definition, then

$$x^2=4z^2$$

or

$$\frac{x^2}{2}=2z^2$$

and

$$A_y=\pi(2z^2+2z^2)=4\pi z^2$$

Having thus evolved a simplified equation for the Area A_y of the elliptical cross-section at any depth y, we can express the volume dV of an infinitesimal layer of liquid of thickness dy as

$$dV=A_y\,dy=4\pi z^2\,dy$$

and the volume to any depth y can be determined (as with the cylinder) by summation of all such infinitesimal layers from 0 to y, as expressed by the equation

$$V=4\pi\int_0^y z^2\,dy \qquad (5)$$

Substituting $x = 2z$ and $a = 2c$ in Equation (4) for the ellipsoid, it becomes

$$\frac{4z^2}{4c^2}+\frac{(y-b)^2}{b^2}+\frac{z^2}{c^2}=1$$

or

$$\frac{2z^2}{c^2}+\frac{(y-b)^2}{b^2}=1$$

and

$$z^2=\frac{c^2}{2}\left[1-\frac{(y-b)^2}{b^2}\right] \qquad (6)$$

Substituting Equation (6) in Equation (5), the latter becomes

$$V=\frac{4\pi c^2}{2}\int_0^y\left[1-\frac{(y-b)^2}{b^2}\right]dy$$

Integrating,

$$V=2\pi c^2\left[y-\frac{(y-b)^3}{3b^2}\right]_0^y$$

Substituting $c = R/2$ and $b = R$,

$$V=\frac{\pi R^2}{2}\left[y-\frac{(y-R)^3}{3b^2}\right]_0^y$$

$$=\frac{\pi R^2}{2}\left[y-\frac{(y-R)^3}{3R^2}-\frac{R}{3}\right] \qquad (7)$$

which is the calibration equation for the ellipsoid.

To check Equation (7) for the volume of the full ellipsoid, substitute $y = 2R$ in it. Then

$$V = \frac{\pi R^2}{2}\left[2R - \frac{(2R-R)^3}{3R^2} - \frac{R}{3}\right]$$

$$= \frac{\pi R^2}{2}\left(2R - \frac{R}{3} - \frac{R}{3}\right)$$

$$= \frac{\pi R^2}{2}\left(\frac{4R}{3}\right)$$

$$= \frac{2}{3}\pi R^3$$

Summation

The complete calibration equation for the volume of a horizontal tank of length L and radius R and with 2:1 ellipsoidal heads is then the sum of Equations (3) and (7), or

$$V_y = L\left[(y-R)\sqrt{2Ry-y^2} + R^2 \text{ vers}^{-1}\frac{y}{R}\right] + \frac{\pi R^2}{2}\left[y - \frac{(y-R)^3}{3R^2} - \frac{R}{3}\right] \quad \ldots\ldots\ldots\ldots\ldots\ldots (8)$$

where V_y = volume in cu. ft. of liquid at any depth y.

Using Equation (8), the calibration curve for the volume of any given size tank of the above design can be plotted as one line, giving volume versus depth. To obtain the volume in gallons instead of cu. ft., the result must be multiplied by 7.48.

Volumetric Coefficient Curves

This calibration equation can also be used to plot a calibration curve which can be used for any tank by adjusting the volume coefficients for the proper length and diameter. To develop this curve it is necessary to take each of the two component parts of Equation (8), substitute values of unity (1) for L and R, and plot them separately.

This has been done to obtain the curves shown in Fig. 2, with D substituted for the depth instead of y. The C_1 curve gives the volumetric coefficient for the cylindrical portion of the tank, the C_2 curve gives the volumetric coefficient for the elliptical heads of the tank.

To use the curves in Fig. 2 to obtain the volume of a tank at any depth D, it is first necessary to calculate the ratio of the depth to the radius—D/R. Locating this ratio on the horizontal scale, the volumetric coefficients C_1 and C_2 can then be read on the vertical scale.

With these values, then, the volume V_D can be calculated by the formula

$$V_D = C_1(R^2L) + C_2(R^3) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (9)$$

If the heads are hemispherical instead of elliptical, the same curves can be used merely by doubling the C_2 value.

Example of Calculations

To illustrate the use of these volumetric coefficient curves, let's calculate the volume of liquid in a horizontal tank 10 ft. in diameter and 50 ft. long (with 2:1 ellipsoidal heads), when the gauge pole indicates a depth of 3 ft.-3 in., or 3.25 ft. Then

$$D/R = 3.25/5 = .65$$

From Fig. 2, when $D/R = .65$,

$$C_1 = 6.65$$

and

$$C_2 = 3.82$$

Substituting in Equation (9) then,

$$V_D = 6.65(25\times50) + 3.82(125)$$

$$= 8310 + 480$$

$$= 8790 \text{ gal.}$$

To check this method of determining volume, find the volume of the tank when it is full, in which case the D/R ratio will be 2.0, and

$$C_1 = 23.48$$

and

$$C_2 = 15.64$$

Substituting in Equation (9) as before,

$$V_D = 23.48(25\times50) + 15.64(125)$$

$$= 29{,}350 + 1955$$

$$= 31{,}305 \text{ gal.}$$

Checking by arithmetic,

$$V = \pi R^2 L + \frac{2}{3}\pi R^3$$

$$= 3.14\times25\times50 + .667\times3.14\times125$$

$$= 3927 + 262$$

$$= 4189 \text{ cu. ft.}$$

$$= 31{,}338 \text{ gal.}$$

which indicates an accuracy of approximately .1%, far closer than it is usually possible to measure the depth of liquid within the tank.

Reprints Available

An enlarged working copy of the "Calibration Curve for Horizontal Cylindrical Tanks" (with the D/R Ratio scale calibrated in hundredths and the Volumetric Coefficient scale in tenths) is being prepared in reprint form.

The reprints will include explicit instructions for using the chart, tables of the squares and cubes for all tank diameters up to 288 inches, and the complete text describing development of the curves. They will be printed on a heavy grade of sturdy paper, suitable for continued use around the laboratory, refinery and service station.

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The Mechanism of Failure of 18 Cr-8 Ni Cracking Still Tubes*

*By C. L. Clark** and J. W. Freeman****

A metallurgical examination was made of 18 Cr-8 Ni cracking still tubes which had been in service for time periods ranging up to 97,520 hours. In the "as-service" condition these tubes possessed entirely different characteristics; for (a) some were still ductile on the basis of the flattening test, (b) others were brittle but could have their ductility restored, while (c) others were permanently brittle.

On the basis of the result obtained, it is believed that the deterioration, and possible actual failure of 18 Cr-8 Ni cracking still tubes in service is due to structural changes at the grain boundaries which are progressive in nature and are dependent on time, temperature and stress. These structural changes consist first of the precipitation and growth of highly alloyed ferrite due to the decomposition of austenite.

When these precipitated areas have grown to a certain size, cracking, at first nearly submicroscopic in nature, will occur under certain conditions of time, temperature and stress. When this cracking has occurred the tube is permanently brittle but at any time prior to the cracking the tube is either ductile or can have its ductility restored.

THE austenitic 18 Cr-8 Ni steel has found wide use in the petroleum industry during the past 10 to 15 years as cracking still tubes in those units where the corrosion has been very severe, due to the processing of the so-called sour crudes. In general, the performance of this steel has been satisfactory and many of the original tubes are still in service after operating time periods up to 100,000 hours (11.4 years). In general, the temperature of the tubes in these installations has been held to a maximum of 1200 to 1250° F.

However, during this time period, certain of these tubes have actually failed while others have undergone rather pronounced changes in their physical properties. As a result of these experiences with 18 Cr-8 Ni tubes, the following questions can be raised:

1. Is the failure caused by progressive intergranular oxidation, or corrosion, either at the normal operating temperature of 1200 to 1250° F. or during possible relatively short periods of overheating at the more elevated temperatures?
2. Or is this failure primarily due to structural changes which occur within the steel either at normal operating temperatures or during overheating? If structural change is responsible, what is its character?
3. Why can the ductility of embrittled tubes, as measured by the flattening test, sometimes be restored by heating to 1500 to 1900° F., while at other times this treatment is ineffective?

As a result of new processes, introduced by the present emergency, 18 Cr-8 Ni tubes are now operating at metal temperatures up to the order of 1650° F. This has introduced other interesting metallurgical problems but the present paper is confined to those cases in which the maximum normal operating temperatures has been 1200 to 1250° F.

Materials Investigated

Through the cooperation of certain petroleum companies, cracking still tubes of 18 Cr-8 Ni were obtained which had been in service for time periods ranging from 35,000 to 97,500 hours. Certain of these tubes had actually failed in service, some were still ductile, others were brittle but could be rejuvenated, while still others were permanently embrittled. Pertinent data with respect to these tubes are summarized in Table I.

Insofar as the chemical composition is concerned, all of the analyses, except that of Tube A, are within the present range for 18-8, although there are certain variations in the carbon, chromium and nickel contents. It is worthy of note that Tube A, whose carbon content is slightly beyond the 0.08% maximum now permitted, became brittle during service but it could have its ductility restored by rejuvenation treatments at 1500 to 1900° F. On the other hand, Tube C-2, containing lower carbon, became permanently brittle during service.

Likewise, all of the tubes were coarse-grained, the ASTM grain size being 4 or coarser. These tubes were, of course, processed several years ago and at that time it was general practice to water quench or air cool from temperatures of 1900° F. or higher, and either of these treatments produces a coarse grain size in this steel.

In addition to the chemical analyses, given in Table I, all of the tubes were submitted to a visual and macroscopic examination, to flattening tests, to a magnetic examination, to the Strauss corrosion tests and to a microscopic examination. In addition, a hardness survey, room temperature tensile and 1200° F. stress-rupture tests were conducted on those tubes for which there was sufficient material available.

Experimental Results

The results obtained from the various tests undertaken are summarized in the following sections:

Visual Examination—Differences existed in the physical appearance of the various tube sections. Tubes A, C-1 and C-2 showed slight general oxidation with the scale layer being thin and tightly adherent, while there was little evidence of oxidation on Tubes D and E. Tube B showed a condition on the outside surface, often referred to as fish scale, and probably resulting from intergranular attack.

Only one of the tube sections submitted, Tube B, was cracked to failure and this crack occurred on the fireside. The sections of Tubes A, C-1 and C-2, were taken from tubes which had cracked in service but the sections submitted were from positions an appreciable distance from the actual failure. Tubes D and E had not failed in service but were removed because the wall thickness had decreased to the limit set by the refinery.

Measurements of the tube wall showed some thinning on the fireside and an increase in the diameter across this point, thus indicating that plastic deformation or creep, had occurred during service. However, the decrease in wall thickness and increase in diameter were both of a low order of magnitude. Some of the tubes likewise showed evidence of metal loss on the inner surface due to corrosion and the action of the tube cleaner. Purely on the basis of visual inspection, all of the tube sections submitted, except Tube B, which was actually cracked, would have been rated as capable of further service in cracking units.

Macro-Examination—The macrostructures of complete rings taken from each of the tube sections are shown in Fig. 1. Although only one ring from each tube is shown in this figure, several were taken at different points along each tube and the comments given are based on this complete examination. The macrostructures of all the tube sections, with the possible exception of Tube B, showed sound metal free from visual defects. In this case of Tube B small circumferential bursts are visible in the tube wall but these are believed to have occurred in

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*Presented at the Twenty-sixth Annual Convention of the American Society for Metals, Cleveland, Oct. 17, 1944.

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***Research Engineer, Department of Engineering Research, University of Michigan, Ann Arbor.

TABLE I—Pertinent Data on 18-8 Cracking Still Tubes Investigated

A. Chemical Composition

Tube Designation	C	Mn	P	S	Si	Cr	Ni	Cu	N_2	Al	Sn
A	0.085	0.44	0.015	0.014	0.74	17.37	9.13	0.12	0.042	0.010	0.01
B	0.07	0.42	0.015	0.011	0.33	18.28	9.13	0.11	0.103	0.005	0.02
C-1	0.07	0.43	0.014	0.012	0.44	17.63	9.07	0.07	0.040	0.008	0.01
C-2	0.07	0.42	0.015	0.011	0.41	17.55	9.11	0.06	0.040	0.005	0.01
D	0.06	0.36	0.017	0.013	0.34	18.13	8.54	....	....	....	....
E	0.06	0.34	0.017	0.014	0.36	18.01	8.44	....	....	....	....

B. Service Life and Reported Condition After Service

Tube Designation	Service Life Hours	Condition After Service
A	35,000	One section cracked. Balance of tube brittle but capable of rejuvenation at 1500 or 1900 degrees Fahr. (815 or 1040 degrees Cent.).
B	40,055	One section cracked. Balance of tube brittle with erratic response to rejuvenation treatment.
C-1	78,000	Section of tube still ductile after service.
C-2	78,000	This section of tube is opposite end of Tube C-1. Certain sections cracked in service and balance was permanently brittle.
D	97,500	Fairly ductile after service and capable of rejuvenation.
E	97,520	Fairly ductile after service and capable of rejuvenation.

Note: Comparative ductility determined by flattening tests on complete tube rings cut from the respective tubes.

service rather than having been present in the original tube.

While all of the tubes were of good quality the following differences were noted in their etching characteristics:

1. One section of the circumference of Tubes A, B, D and E etched more readily and deeper than the remaining areas, with the more readily attacked region corresponding to the fireside during service. The width of this deeper etched area was more extended in Tubes A and B.

2. Tubes C-1 and C-2 etched uniformly around the entire circumference but the tubes differed in that the permanently brittle Tube C-2 etched more readily and deeper, being similar in this respect to the fireside of the remaining tubes.

3. In almost every case a narrow band on the inner surface etched to a greater extent than the balance of the tube wall. As will be shown later this condition is due to slight carburization and to cold working produced by the tube cleaners.

In general, it may be concluded that while the macro-examination revealed differences in structure it did not indicate the cause of brittleness in certain of the 18-8 tube sections after service.

Flattening Characteristics—The flattening test is the means often employed to determine the ductility characteristics of tubes after service. It has been found to be much more selective in this respect than are the ductility values obtained from the tensile tests. Accordingly, a large number of rings from each of the tube sections were subjected to this test both in the "as-service" condition as well as after the so-called rejuvenation treatments at 1500 to 1900° F.

In addition, tube rings were flattened after certain amounts had been machined from the inner and outside walls in order to ascertain if surface attack might be a contributing cause, at least, of the brittleness. The location of each of the test rings, the manner in which they were treated, and the results obtained from the flattening tests are shown diagrammatically in Fig. 2. The following comments may be made with respect to the flattening characteristics of each of the tubes:

1. Tube A was brittle in the as-service condition but its ductility could be fully restored by a ½-hour heating period at 1500 or 1900° F. On the other hand, machining 0.050 in. from either the outside or inside surface had little if any influence on the degree of flattening.

2. Tube B was likewise brittle in the "as-service" condition but it exhibited erratic response to rejuvenation at 1500 and 1900° F.

3. Tube C-2 was classified as permanently brittle for complete ductility could not be restored by any of the treatments used. This was true even when an annealing temperature of 2200° F., followed by water quenching, was used. Likewise machining metal from either the outside or inside wall did not improve the flattening properties.

4. On the other hand, Tube C-1 which was from the same tube length as Tube C-2, but from the opposite end, was completely ductile in the "as-service" condition.

5. Both Tubes D and E possessed a good degree of ductility in the "as-service" condition. In both cases the ductility was further improved by the 1500° F. treatment, but the tube rings could only be completely flattened after the 1900° F. heat treatment.

In addition to the above observed differences in the overall flattening characteristics of these tubes, differences likewise existed with respect to the location of the fracture. In all of the tubes except C-2, the fracture, when it did occur, was generally confined to the fireside of the tube, while with Tube C-2 it was not.

On the basis of these findings, it is evident that, when the flattening test is used to evaluate the ductility characteristics of tubes after service, pronounced differences may be found to exist not only in different tubes but in various sections of the same tube as well as around the circumference of a given tube ring.

Room Temperature Tensile Properties—Because of the amount of stock available tensile tests could only be conducted on Tubes A, D and E. These tubes were considered only in the "as-service" condition and strip tensile specimens were taken at the fireside, opposite the fireside, and 90 degrees to the fireside. The results obtained are given in Table II.

The variations found in the properties within each tube were not very pronounced, the only consistent difference being a somewhat lower strength and ductility on the fireside. The strength values of Tubes A and E were somewhat

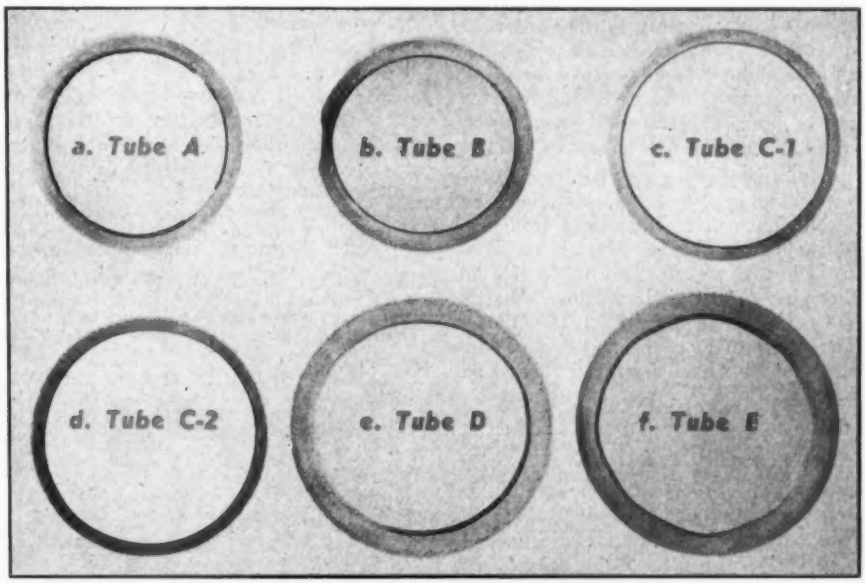

Fig. 1—Macrostructures of 18-8 tubes after service

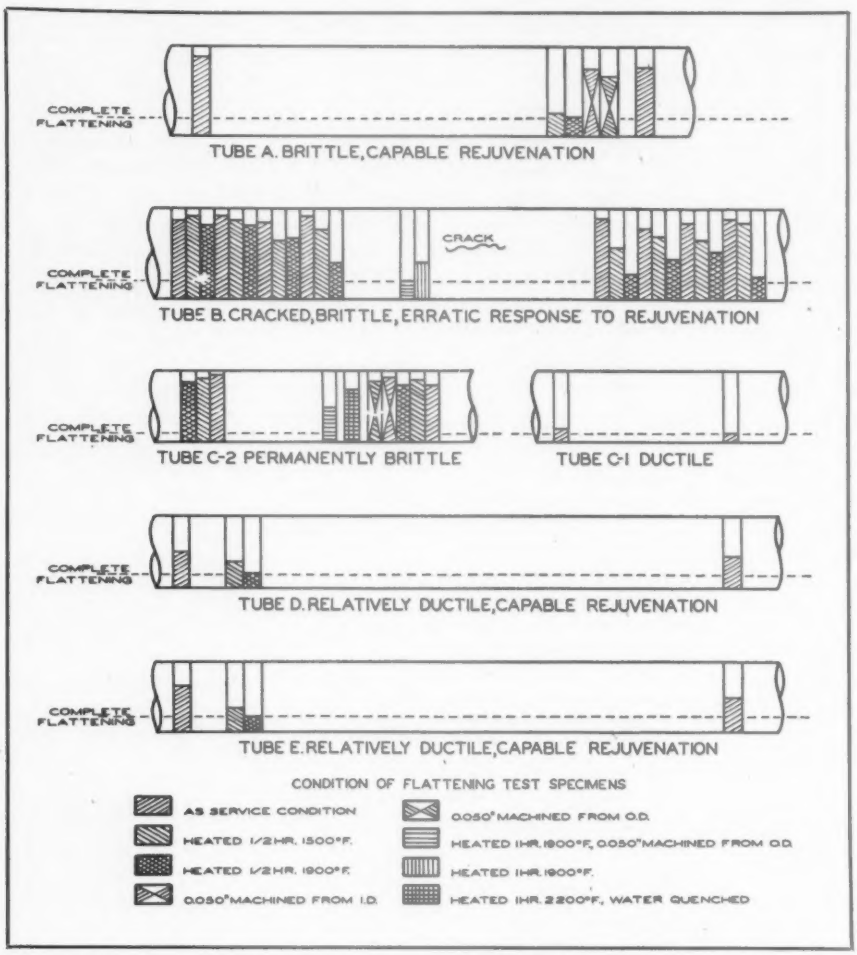
COMPLETE FLATTENING
TUBE A. BRITTLE, CAPABLE REJUVENATION
CRACK
COMPLETE FLATTENING
TUBE B. CRACKED, BRITTLE, ERRATIC RESPONSE TO REJUVENATION
COMPLETE FLATTENING
TUBE C-2 PERMANENTLY BRITTLE
TUBE C-1 DUCTILE
COMPLETE FLATTENING
TUBE D. RELATIVELY DUCTILE, CAPABLE REJUVENATION
COMPLETE FLATTENING
TUBE E. RELATIVELY DUCTILE, CAPABLE REJUVENATION
CONDITION OF FLATTENING TEST SPECIMENS
AS SERVICE CONDITION
HEATED 1/2 HR. 1500°F.
HEATED 1/2 HR. 1900°F.
0.050" MACHINED FROM I.D.
0.050" MACHINED FROM O.D.
HEATED 1 HR. 1900°F, 0.050" MACHINED FROM O.D.
HEATED 1 HR. 1900°F.
HEATED 1 HR. 2200°F, WATER QUENCHED

Fig. 2—Results of flattening tests on five 18-8 chromium-nickel tubes after designated heat treatments

higher than those generally obtained in quenched 18 Cr-8 Ni tubes but this increase may be due either to the cold working on the inner surface, caused by the tube cleaner, or to structural changes.

The outstanding finding from these tests is that all of the tubes showed reasonably good ductility in the "as-service" condition, while the flattening tests showed Tube A to be brittle when in this condition. In other words, the flattening test is more selective and critical for this purpose than the tensile test.

Hardness Survey—A hardness survey was made around the circumference and across the wall of tube rings from each of the tubes. Typical results for Tubes A, D and E are given in Table III. The three tubes differed in hardness, that for Tube A ranging from 67 to 85, that of Tube D from 77 to 93, and that of Tube E from 63 to 81 Rockwell "B". Likewise as shown by the preceding values there were hardness differences within each tube. In general, the hardness tended to be harder towards the inner surface and this increase is due to a slight degree of carburization as well as to the cold working during tube cleaning.

Strauss Corrosion Resistance — The Strauss corrosion test was conducted on ⅛-inch square rings machined from the center of the tube wall of each of the tube sections. These tests were conducted in the "as-service" condition as well as after rejuvenation treatments at 1500 to 1900° F. Likewise certain of the specimens were heated at 1100 and 1200° F. prior to the test. The results obtained are summarized in Table IV. The following conclusions are indicated by these findings:

1. All of the tubes were susceptible to the Strauss corrosion test in the "as-service" condition and all were immune after the rejuvenation treatments at either 1500 or 1900° F.

2. However, differences did exist in the "as-service" specimens in the location of the attack around the circumference of the rings. Tubes A and B were attacked at all locations except at the fireside; with Tubes C-2 and D the attack occurred only at the fireside; with Tube C-1 the attack was general, while with Tube E it was confined to about 90 degrees from the fireside.

3. Heating the "as-service" tubes at 1100 or 1200° F. increased the time required for, and changed the location of, the attack.

These findings would, therefore, indicate that the Strauss corrosion results do not differentiate between these tubes in the same manner as the flattening tests.

Magnetic Characteristics—A qualitative measure of the comparative magnetic characteristics of the different tubes was obtained by measuring the angle through which specimens suspended by a thread could be pulled with a strong permanent magnet. It is recognized that this procedure is not too accurate but it is sufficiently sensitive to reveal rather slight differences in the magnetic characteristics of austenitic steels provided all test details are held constant.

Significant differences were revealed in the magnetic characteristics of specimens from each of these tubes. Specimens from the fireside of Tubes A and B responded to the magnet five times as strongly as specimens from the remainder of the tube walls. All portions of the circumference of Tube C-2 were as magnetic as the fireside sections of Tubes A and B while Tube C-1 was even less magnetic than the specimens away from the fireside of Tubes A and B. Tubes D and E were slightly more magnetic than Tube C-1, with Tube D being the more magnetic of these two.

The results from the magnetic tests on the "as-service" tubes are therefore in fairly good agreement with the flattening tests, as the most brittle tube had the greatest magnetism and the most ductile tube the least. Likewise, the position of maximum magnetism around the circumference coincided with the location of cracking in the flattening test. On the other hand, the rejuvenation treatment at 1500° F. removed little if any of the

TABLE II—Room Temperature Tensile Properties of Three 18 Cr-8 Ni Tubes After Prolonged Service

Tube Designation	Service Life Hours	Location of Specimen	Tensile Strength Lb./Sq. In.	Yield Point Lb./Sq. In.	Elongation in 2 In. Per Cent
A	35,000	Fireside	92,500	32,600	38.0
		Opposite Fireside	96,700	33,250	41.0
		90° to Fireside	96,800	25,700	41.5
		90° to Fireside	95,800	26,500	44.0
D	97,500	Fireside	84,300	29,000	30.5
		Opposite Fireside	86,400	32,000	30.5
		90° to Fireside	89,100	35,000	47.0
		90° to Fireside	87,100	34,000	40.5
E	97,520	Fireside	95,400	21,600	39.5
		Opposite Fireside	99,400	24,800	44.0
		90° to Fireside	96,500	21,000	45.5
		90° to Fireside	96,500	29,900	44.5

Note: Yield point obtained by dividers. Strip specimens 1 inch wide at gage length.

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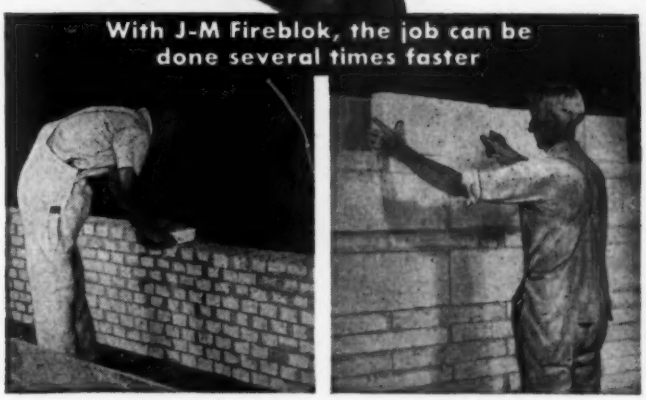

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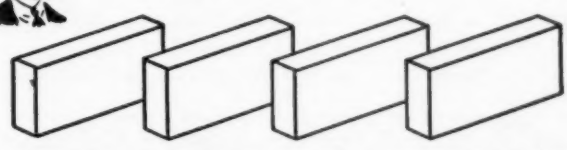

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TABLE III—Hardness Survey of Rings from 18 Cr-8 Ni Tubes After Prolonged Service

Tube Designation	Service Life Hours	Location of Specimen	Rockwell "B" from Outside to Inside of Tube
A	35,000	Fireside	67, 81, 82, 82, 82, 82
		Opposite Fireside	75, 81, 81, 82, 85, 84
		90° to Fireside	78, 82, 82, 82, 83, 84
		90° to Fireside	73, 82, 82, 83, 85, 84
D	97,500	Fireside	77, 83, 85, 85, 89, 90
		Opposite Fireside	82, 85, 85, 85, 86, 93
		90° to Fireside	84, 85, 86, 86, 86, 88
		90° to Fireside	85, 86, 86, 86, 88, 90
E	97,520	Fireside	71, 79, 80, 79, 81, 80
		Opposite Fireside	64, 78, 78, 79, 79, 80
		90° to Fireside	68, 77, 78, 79, 80, 81
		90° to Fireside	63, 77, 78, 79, 81, 80

TABLE IV—Results from Strauss Corrosion Tests on Ring Samples of 18 Cr-8 Ni Still Tubes After Prolonged Service

Tube Designation	Service Life Hours	Condition	Time for Failure Hours	Type Failure	Location of Failure
A	35,000	As Service	30	General	Every Place but Fireside
		1500° F.— 1 Hr.	N.F.	.....	.....
		1900° F.— 1 Hr.	N.F.	.....	.....
B	40,055	As Service	23	General	Every Place but Fireside
		1500° F.— 1 Hr.	N.F.	.....	.....
		1900° F.— 1 Hr.	N.F.	.....	.....
C-1	78,000	As Service	195	General	Complete Ring
		1500° F.— 1 Hr.	N.F.	.....	.....
		1900° F.— 1 Hr.	N.F.	.....	.....
		1100° F.—24 Hr.	386	Localized	45° from Fireside
		1200° F.—24 Hr.	386	Localized	45° from Fireside
C-2	78,000	As Service	150	Localized	Single Point Attack
		1500° F.— 1 Hr.	N.F.	.....	.....
		1900° F.— 1 Hr.	N.F.	.....	.....
		1100° F.—24 Hr.	288	General	Complete Ring
		1200° F.—24 Hr.	288	General	Complete Ring
D	97,500	As Service	528	Localized	At Fireside
		1500° F.— 1 Hr.	N.F.	.....	.....
		1900° F.— 1 Hr.	N.F.	.....	.....
E	97,520	As Service	45	Localized	90° from Fireside
		1500° F.— 1 Hr.	N.F.	.....	.....
		1900° F.— 1 Hr.	N.F.	.....	.....

N.F. = Not Fractured in 528 hours.

magnetism, while it was, in many cases, beneficial in improving the flattening characteristics. The treatment at 1900° F. did, however, completely remove the magnetism.

Rupture Properties at 1200° *F.*—Because of the amount of material available the rupture tests were conducted on a limited number of specimens from Tubes A, D and E and confined to a temperature of 1200° F. Because of the previously noted differences in physical properties around the circumference of certain of these tubes, specimens were taken at the fireside, opposite the fireside and 90 degrees to the fireside. The dimensions of the tube wall required the use of 0.250-in. diameter by 1-in. gage length specimens. All tests were confined to the "as-service" condition. The results obtained from these tests, given in Table V and Fig. 3, indicate the following:

1. In each tube the fireside was considerably weaker than the other three sides. However, only in the case of Tube D did this section have low ductility.

2. In each tube the material opposite the fireside had the highest strength in the rupture test.

3. Tube A, which was classified as "brittle" by flattening tests on the "as-service" tube, had higher rupture strength and ductility than the other two tubes or water-quenched bar stock. Tube D possessed the lowest strength.

While these results show appreciable differences to exist in the rupture characteristics from tube to tube and also around the circumference of the individual tubes there was no direct correlation between the rupture or ductility characteristics at 1200° F. and the behavior in the flattening test at room temperature. In fact, Tube A, which was brittle in the room temperature flattening test, possessed the highest strength and ductility at 1200° F.

Microscopic Examination—A thorough metallographic examination was made of each of the sections submitted both in the "as-service" condition and after rejuvenation treatments at 1500 and 1900° F. as well as at higher temperatures. Representative structures of the tubes in the "as-service" condition are shown at 100 diameters in Fig. 4. A comparison of the various microstructures permits the following generalizations with respect to the degree of structural changes and to the influence of rejuvenation heat treatments:

1. In the "as-service" condition all of the tubes were similar in certain respects, but not necessarily to the same degree, in that

a. Precipitation was present in the grain boundaries. With a light etch, the grain boundary precipitation was similar around each tube and from tube to tube.

b. Twinning was present as shown in Fig. 4.

c. The grain size was of the same order of magnitude and on the coarse side, being 4 or larger (Fig. 4).

d. Cold working had occurred on the inner wall, examples of which are given in Fig. 5.

e. Cracks already present in the tubes or those developed during the

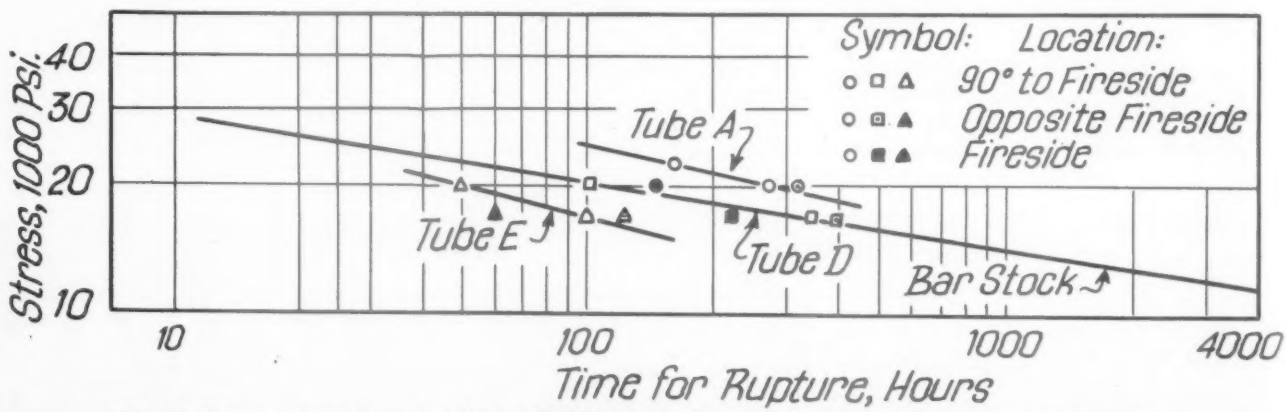


Fig. 3—Stress-rupture characteristics at 1200°F. of 18 chromium-8 nickel tubes after prolonged service

flattening tests all followed the grain boundaries, Fig. 6.

2. In the "as-service" condition the following differences existed in the tube sections submitted:

a. Insofar as outside surface cracking is concerned, Tube C-1 showed more surface cracking, Tubes A, D and E very little, Tube B somewhat more at the fireside and Tube C-2 relatively severe cracking all around the tube (Fig. 7).

b. All of the tubes showed carburization on the inner wall except Tube C-1 (Fig. 5).

c. Veining was present to the greatest extent in Tube C-2 and to a lesser extent in Tube A at the fireside (Fig. 4).

d. Deep etching revealed large precipitated particles in the grain boundaries at the fireside of Tube B and entirely around the circumference of Tube C-2. The same was true to a lesser extent, except at the extreme outer surface on the fireside, of Tube A, D and E, and to even a smaller extent on Tube C-1.

3. Rejuvenation treatments at 1500° F. produced no visual changes in microstructures of any of the specimens (Fig. 8).

4. Rejuvenation treatments at 1900° F. exerted variable effects on the microstructures of the different specimens.

a. In all the tubes except Tube C-2 the precipitated constituents were nearly completely eliminated by this treatment (Fig. 9).

b. A "new structure" became visible completely around the circumference of Tube C-2 and to a limited extent on the fireside of Tube B. In Tube C-2 this structure was largely confined to the outer half of the tube wall and was orientated radial to the outside surface and lengthwise to the tube (Fig. 10).

c. This "new structure" could not be removed by solution treatments at temperatures as high as 2400° F.

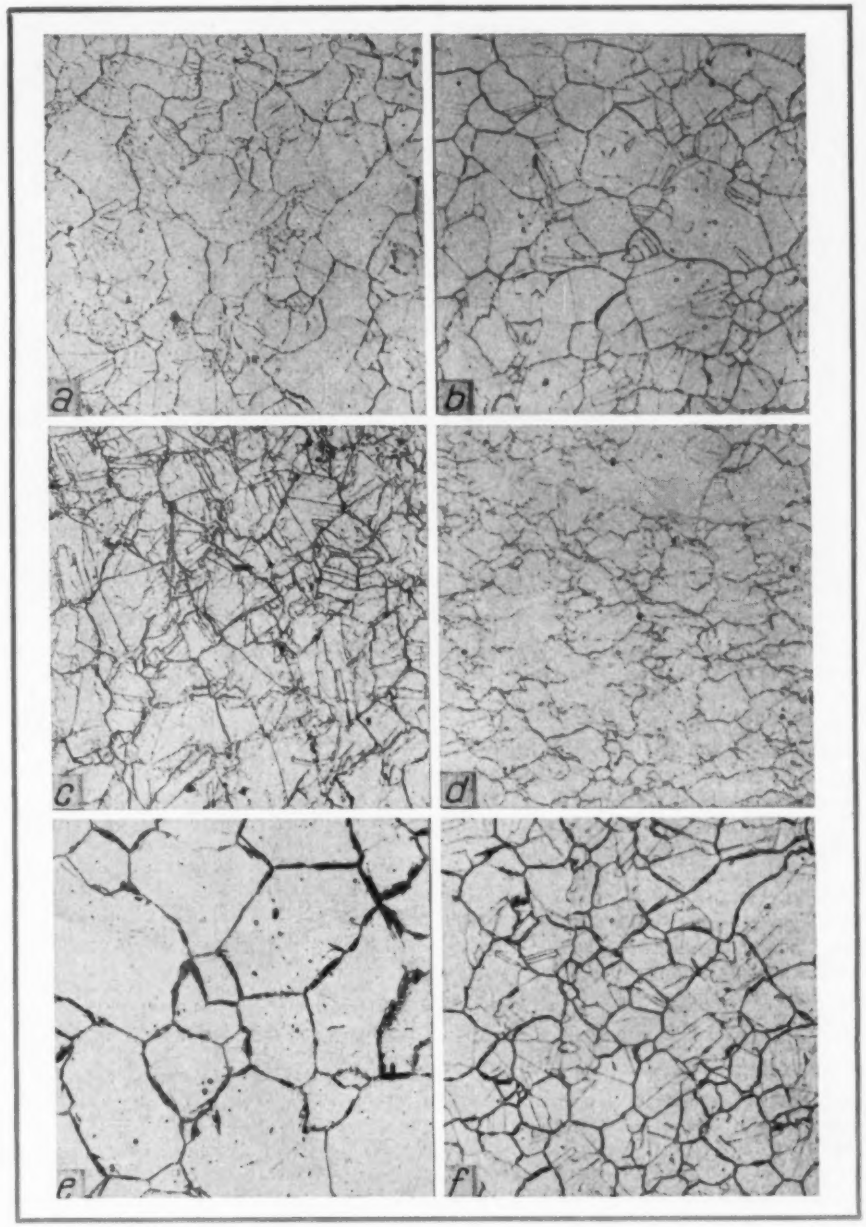


Fig. 4—Microstructures in as-service condition. × 100. (a) Fireside of tube A. (b) Fireside of tube B. (c) tube C-2. (d) tube C-1. (e) tube D. (f) tube E

TABLE V—Rupture Test Characteristics at 1200 F. of Three 18 Cr-8 Ni Tubes After Prolonged Service

Tube Designation	Service Life Hours	Location of Specimen	Stress Lb./Sq. In.	Rupture Time Hours	Elongation in 1 In. Per Cent	Reduction of Area Per Cent
A	35,000	Fireside	20,000	145.5	21.0	23.8
		Opposite Fireside	20,000	316.0	27.0	28.2
		90° to Fireside	20,000	272.0	22.0	24.0
		90° to Fireside	22,500	161.0	25.0	28.8
D	97,500	Fireside	17,000	70.0	8.0	14.6
		Opposite Fireside	17,000	123.0	16.0	18.9
		90° to Fireside	17,000	99.5	17.0	16.1
		90° to Fireside	20,000	49.5	21.0	20.3
E	97,520	Fireside	17,000	227.0	13.0	13.9
		Opposite Fireside	17,000	391.0	12.0	15.4
		90° to Fireside	17,000	339.0	13.0	16.8
		90° to Fireside	20,000	99.0	19.0	20.4
Bar Stock	W.Q. 2000° F.	.....	17,000	308.0	18.0	17.4

Comparative 100-Hour Rupture Strengths:

Tube A ..... 25,000 lb. per sq. in.
Tube D ..... 17,000 lb. per sq. in.
Tube E ..... 20,000 lb. per sq. in.
Bar Stock ..... 20,000 lb. per sq. in.

5. Surface cracking produced during service as well as the cracks produced during the flattening tests followed this "new structure."

From the metallographic examination it would appear that the development of actual cracks and embrittlement of the metal, as determined by the flattening test, is due to alterations of the structure. Tube C-1 was ductile in the "as-service" condition and the metallographic structure, even after prolonged etching, did not show the presence of many large grain boundary particles. In the "as-service" condition Tubes A, B and C-2 did show numerous large grain boundary particles and while these were confined to the fireside of Tubes A and B they existed throughout Tube C-2. All of these tubes cracked during flattening.

After rejuvenation at 1900° F., the structures of Tubes A, D and E became

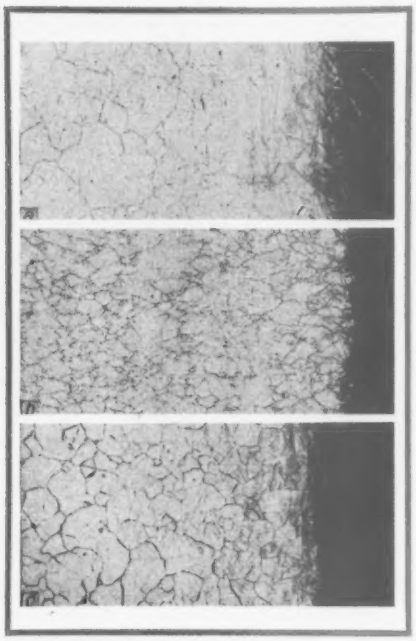


Fig. 5—Examples of inner wall structures. × 50. (a) Tube B, (b) tube C-1, (c) tube E

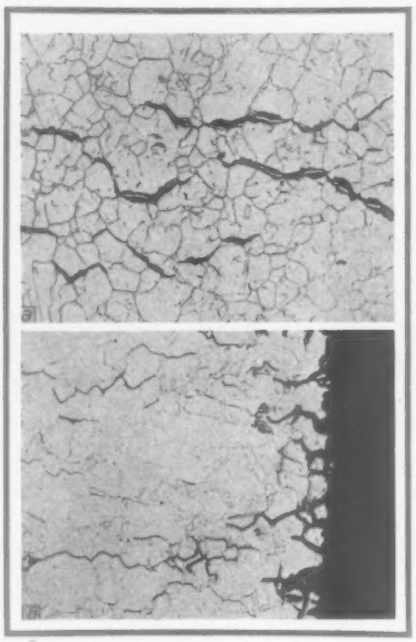


Fig. 6—Intergranular characteristics of cracking in 18-8 tubes. × 50. (a) Tube B—cracking developed during service. (b) tube C-2—cracking developed during flattening. Specimen heated at 1900°F. prior to flattening

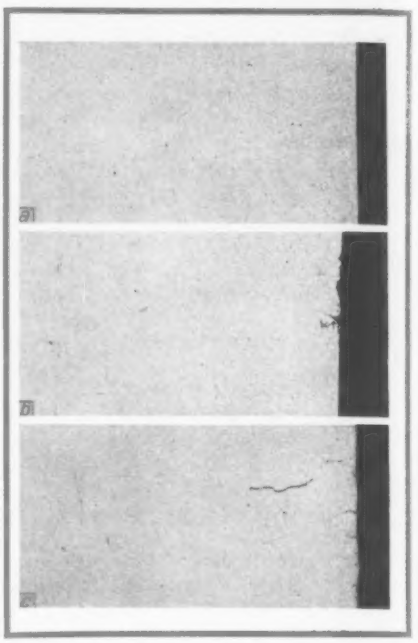


Fig. 7—Varying degrees of outside surface cracking. × 50. (a) Tube C-1, (b) tube A, (c) tube C-2

normal and the tubes could be flattened. On the other hand, a so-called "new structure" became visible in Tube B on the fireside side and completely around the outer part of the wall of Tube C-2. Neither Tube B or C-2 could be flattened without cracking and the cracks followed this "new structure." The evidence, therefore, points to different degrees of deterioration. The grain boundary change in Tube C-1 had not progressed to a sufficient extent to cause brittleness, while in Tubes A, D and E it had. With these latter tubes, however, this structural change could be removed by heat treatment.

In the case of Tubes B and C-2 it is believed that the embrittlement caused by the grain boundary particles has been further complicated by the development of the "new structure." This condition resulted in poor response to the rejuvenation treatments since the "new structure" apparently cannot be eliminated by heat-treatment.

On the basis of these findings it is apparent that the flattening test and microscopic examination are the best means available for determining if 18 Cr-8 Ni steel has undergone changes in its physical characteristics after prolonged service at normal temperatures of 1200 to 1250° F. Chemical composition, within the normal limits, yields no information in this respect for it so happens that the two tube sections showing the maximum variations, Tubes C-1 and C-2, were from different sections of the same tube.

Likewise the visual examination, the

Fig. 8—Influence of rejuvenation treatment at 1500°F. on the microstructure. × 500. (a) Tube E, (b) tube C-2

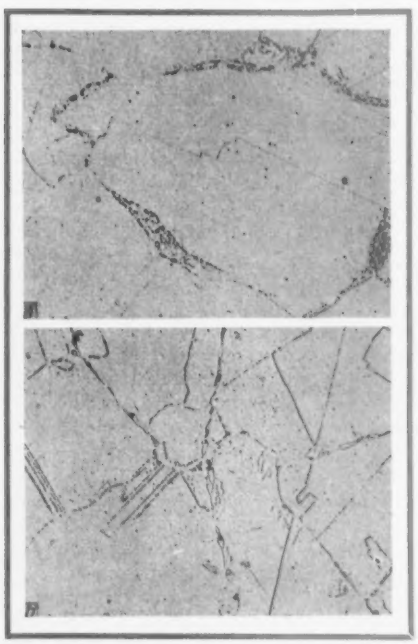


Fig. 9—Influence of rejuvenation treatment at 1900°F. on the microstructure. × 500. (a) Tube E, (b) tube C-2

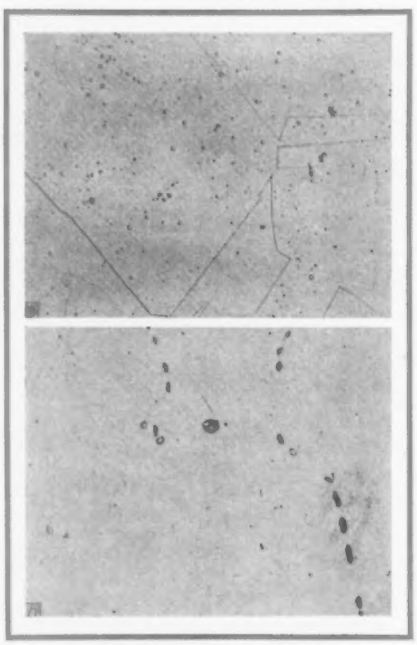
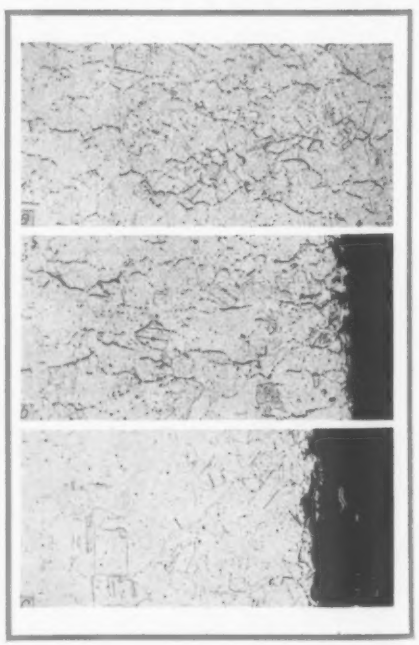


Fig. 10—Microstructures of "new structure" in Tube C-2 after 1900°F. rejuvenation. × 50. (a) General structure, (b) outside surface, (c) inside surface



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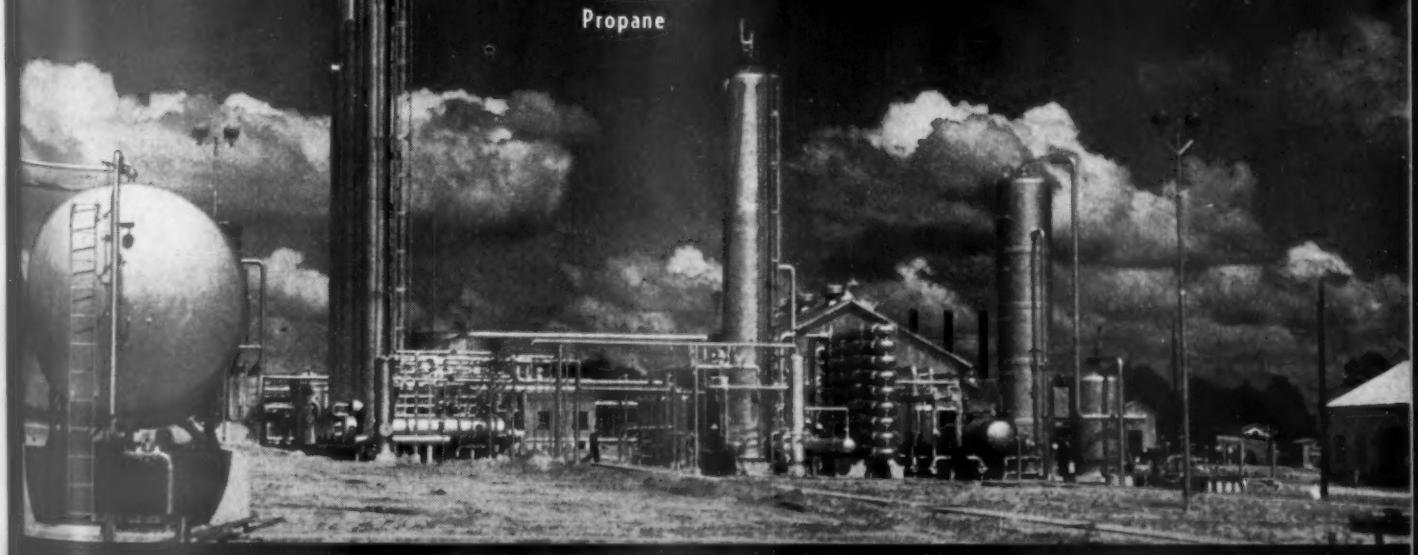

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Export Terminals: Corpus Christi, Port Arthur and Norsworthy, Houston, Texas, Lake Charles, La., and Marcus Hook, Pa.

hardness survey, the Strauss corrosion test and the room temperature tensile properties did not differentiate between these tubes in the same manner as the flattening tests or microscopic examination. Under certain conditions a fairly definite correlation existed between the magnetic characteristics, the macrostructure, and the flattening properties but this did not hold true under all conditions, and especially after the rejuvenation treatments. The explanation for these structural changes is not nearly as clear as the correlation between structure and flattening characteristics.

Metallographic examination cannot positively identify the large particles revealed in the grain boundaries of the brittle areas by heavy etching. Association of the etching characteristics suggests very strongly that these particles are ferrite. This is also confirmed by the magnetic characteristics. The so-called "new structure" is entirely different from anything previously observed in similar alloys. Actual cracks, when present, terminate in this structure and when cracks are produced, as in flattening, they pass through it.

In the severely cracked areas actual cracks are visible in the unetched condition which closely resemble it. Since it cannot be eliminated by solution heat treatments it is believed to be very small cracks which surround the large particles present in the grain boundaries of the unheat treated material. These are undoubtedly very small and are invisible under the microscope due to the flowed metal during polishing and are only revealed after etching has removed this flowed metal and has enlarged the cracks.

The orientation of the "new structure" radial to the outside surface and lengthwise to the tube and its restriction to the outer half of the tube wall suggests the following possible explanation of actual failure:

1. Gradual precipitation and growth of particles at the grain boundaries under certain conditions of service. These particles are believed to consist of highly alloyed ferrite which at certain temperatures, at least, is brittle.

2. Carbide precipitation may result largely because of the decreased solubility of carbon in this highly alloyed ferrite.

3. During heating and cooling of the tube, and other temperature fluctuations, cracks may develop around and in the ferrite areas due to stresses caused by volume changes accompanying their formation and to differences in expansion between the ferrite and austenite. The cracking may be assisted by carbide and other possible precipitants in the grain boundary areas, which tend to set up brittle conditions.

4. The presence of stress raisers at the outer surface, such as "fish scale" and intergranular oxidation start cracks which propagate themselves through the "new structure" under the combined influence of thermal stresses and service load stresses.

The evidence points very strongly to localized service conditions influencing the alteration of tube metal structure. In the case of Tubes A and B it was localized on the fireside. Likewise Tube C-2 was affected while Tube C-1 was not and yet they were different sections of the same tube.

Insofar as these tubes are concerned its microstructure clearly shows the affected zones. The tube dimensions also indicate that creep was greater on the fireside and the rupture tests indicate the metal to be weaker in this section. The fact that brittleness was restricted to the fireside in two cases suggests higher temperatures at those points, which is equivalent also to a more overstressed condition, both on the basis of mechanical and thermal stresses. Both of these conditions contributed to increased rates of structural alterations. In the case of Tube C-2, the deterioration completely around the tube suggests that the complete circumference of this tube was overheated or else that the tube may have been rotated at various times during its service life. Such information as is available on these tubes indicates that neither corrosion nor oxidation played an important role in the deterioration of these tubes. It is entirely possible, however, that either of these two factors may have hastened the actual failures which occurred in certain areas of certain of these tubes.

Conclusions

The results obtained permit the following tentative conclusions with respect to the mechanism of failure of 18-8 cracking still tubes in service.

1. Structural alterations occur which are progressive in nature and when they have developed to a certain degree brittle grain boundary conditions result.

2. The degree to which these structural alterations progress and the rate at which they take place are probably largely determined by the actual temperature, stress and time conditions of service.

3. On the basis of the data obtained it is believed the following mechanism is involved:

a. Particles, believed to be highly alloyed ferrite, grow in the grain boundaries under the combined influence of temperature, time and stress.

b. Carbide precipitation follows due to the decreased solubility of carbon.

c. Under certain operating conditions failure can take place microscopically around these ferrite particles due to the magnitude of the stresses present.

d. When the above conditions have been established, then brittle service failures can occur. Actual operating conditions such as temperature and stress fluctuations and stress raisers on the surface determine the degree to which both particle growth and the cracks must progress before service failures occur.

4. So long as the "new structure," believed to be microscopic cracks, does not form around the precipitated grain boundary particles, ductility can be restored to the tubes by rejuvenation treatments at 1500 and 1900° F.

5. Service conditions may vary around the circumference and along the length of cracking still tubes. This condition may result in the severe structural alterations being confined to a small narrow portion of the tube; or to conditions where an entire tube can be embrittled.

6. The variations in structural alterations in different portions of a tube are reflected in metallurgical test results. Some of these properties are influenced more than others. For instance, hardness tests show little difference, tensile tests slight differences, while flattening and rupture tests show wide differences between areas with slight and pronounced grain boundary particle growth.

7. The beneficial effect of the 1500° F. rejuvenation heat treatment is believed due to the elimination of stress and to a possible transformation of the precipitated ferrite. It has little influence on the precipitated carbides, as evidenced by the microscopic examination, and yet it imparted immunity to the Strauss corrosion test.

8. Insofar as these particular tubes are concerned, neither corrosion nor oxidation played an important role in their deterioration or failure. It is believed, however, that when the structural changes have occurred, the corrosion resistance is decreased, and on this basis corrosion or scaling may have contributed to the cracking to failure which occurred at certain locations.

While all of the evidence obtained to date substantiates the theory advanced as to the mechanism of failure, additional work is in progress on this general subject and attempts are being made to reproduce those various structural alterations in the laboratory.

ACKNOWLEDGMENT

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The authors are indebted to the oil companies whose cooperation made the investigation possible and to The Timken Roller Bearing Co. for permission to publish the results.

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Metal Inspection Plays Important Role In Wartime Maintenance Program

Periodic metal inspection of refinery equipment is considered by many oil companies to be even more important now than before the war. One reason for this is that, in much of the equipment installed in the wartime program, it was necessary for the designer to use substitute steels and other metals for grades normally used. Experience as yet is lacking as to how these materials will stand up in actual practice, and regular and perhaps more frequent inspections must be relied on until experience data are available.

While the new catalytic cracking and other processes operate at lower temperatures and pressures than are required for thermal cracking, the handling and use of catalysts of various natures present new problems, such as erosion of equipment by solid catalysts.

The processing of greater volumes of high sulfur crudes in some plants will increase the possibilities for corrosion and necessitate the frequent checking of equipment with which the corrosive liquids and gases may come in contact.

With the increased knowledge of how to judge the serviceability of metals in general which has been developed in the past few years, it may become standard practice for refiners to design for a safety factor closer to actual requirements than in the past. This again would emphasize the importance of metal inspection.

The accompanying article presents the methods and practices used by one large oil company for handling metal inspections, as based on present operating conditions in refineries.

NEW REFINING PRACTICES, despite the radical departure from standard operating methods of the past, have not necessitated the development of new metal inspection methods in plants.

In the experience of Phillips Petroleum Co.'s refining department tube stills continue to be the item of equipment needing most frequent checkup. Certain parts, generally tubes, furnaces and transfer lines, are inspected every time the unit comes down for cleaning out.

Modern catalytic equipment for the most part operates at lower temperatures and pressures than are required in pressure-still operations and in many instances sections of the units handling corrosive materials are isolated and so designed that corrosive liquids or gases cannot get into other streams.

In general it is not necessary to make inspections of the new units as frequently as is general practice with older refining equipment. However, there is one string attached to this statement: Frequent initial inspection on new units is the rule until it has been assured that the corrosion and equipment-attrition rates have been accurately determined.

Corrosion in hydrofluoric acid alkylation equipment has been minimized by use of the appropriate alloy, or in most cases, plain carbon steel. In fact, when the original HF alkylation equipment was installed at one refinery a number of alloys were used in its construction which inspection showed were not satisfactory after the first month of operation. They were replaced by plain carbon steel with tubing of seamless construction. Inspection approximately 10 months later showed no appreciable corrosion, leading to future scheduling of inspections on an annual basis only.

In Phillips Petroleum Co.'s departmental setup, the inspection section is an integral part of the safety division of each refinery. Inspection of facilities logically forms a part of the safety program. It is, however, entirely separate from plant maintenance or operations, responsible only to the plant manager. Under this plan, the chief safety engineer automatically is chief inspector and must, therefore, not only have a knowledge of safety practices, but have sufficient engineering experience to permit him to properly evaluate the condition of equipment.

As a result of this arrangement, the inspection department at a refinery does not ordinarily determine shutdown time for any unit; that is the responsibility of the operating division. However, from information developed during the last previous inspection, the inspector may certify some portion of the unit operable only for a certain length of time before replacement or repair and thus control the date of shutdown. Also, if an emergency develops, he may order an immediate shutdown regardless of the regular schedule.

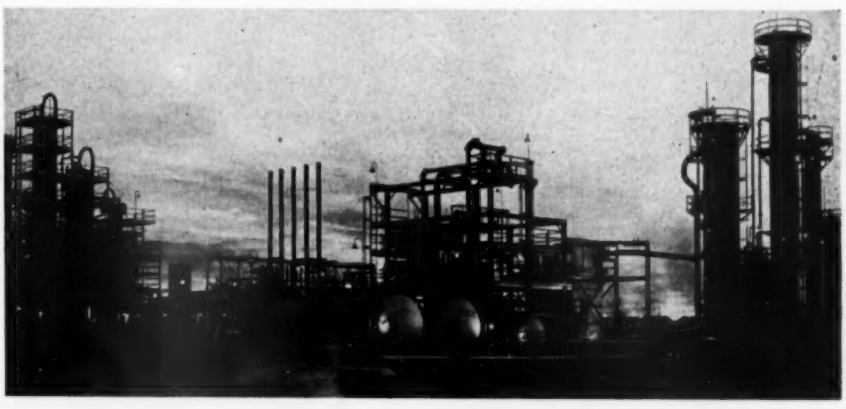
The inspector also may be called upon to act as referee in disputes between operating and maintenance divisions. For example, the operating division might believe a bubble-tower tray should be replaced because it might leak before the next regular shutdown, while maintenance disagreed; the inspector's decision would be final except on appeal to the plant manager.

Setup of the inspection division embraces one chief inspector (safety supervisor) with one or more assistant chief inspectors and a number of field inspectors who perform the actual physical inspection. The number of subordinates to the chief, who is responsible solely to the plant manager, depends on the size of the refinery (i.e. conditions and equipment at Borger, Texas, differ from those at either Kansas City, Kans., or Okmulgee, Okla., as well as its operations). Sufficient clerical help for records, reports and correspondence also is required. For co-ordination, copies of all reports and recommendations for all plants are sent to management at Bartlesville.

Training of Inspectors

Usual qualifications required for an inspector are that he have sufficient education and experience to permit him to interpret results of his findings and make intelligent recommendations. Generally a high-school education is considered sufficient formal education, but extensive operating experience, according to company officials, is essential. In the case of a chief inspector, however, the prospect should have a degree in engineering in addition to operating experience.

Men are selected for an inspectorship from the ranks. Fortunately, officials



Partial view of Phillips Petroleum Co.'s refinery at Borger, Texas

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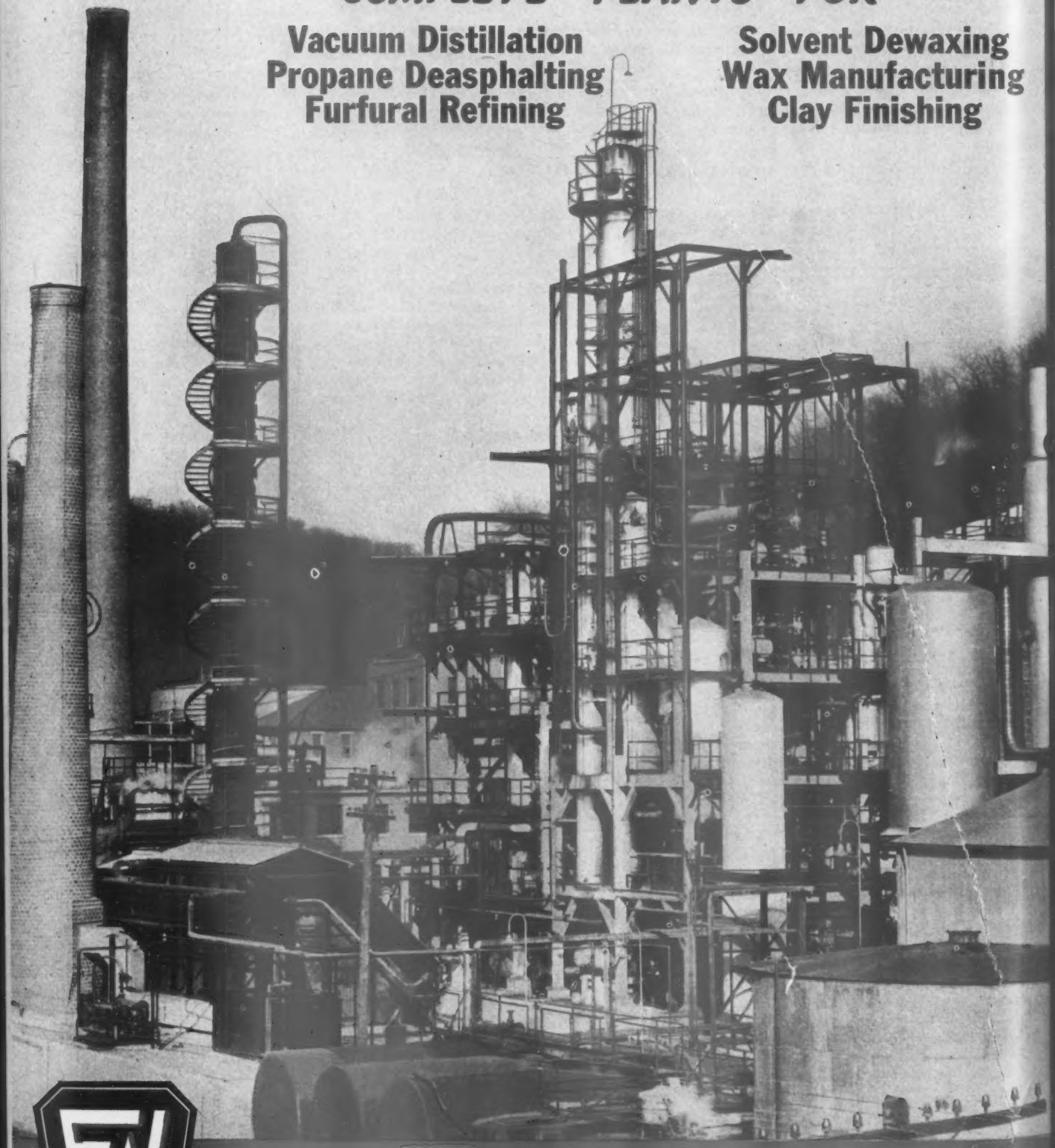

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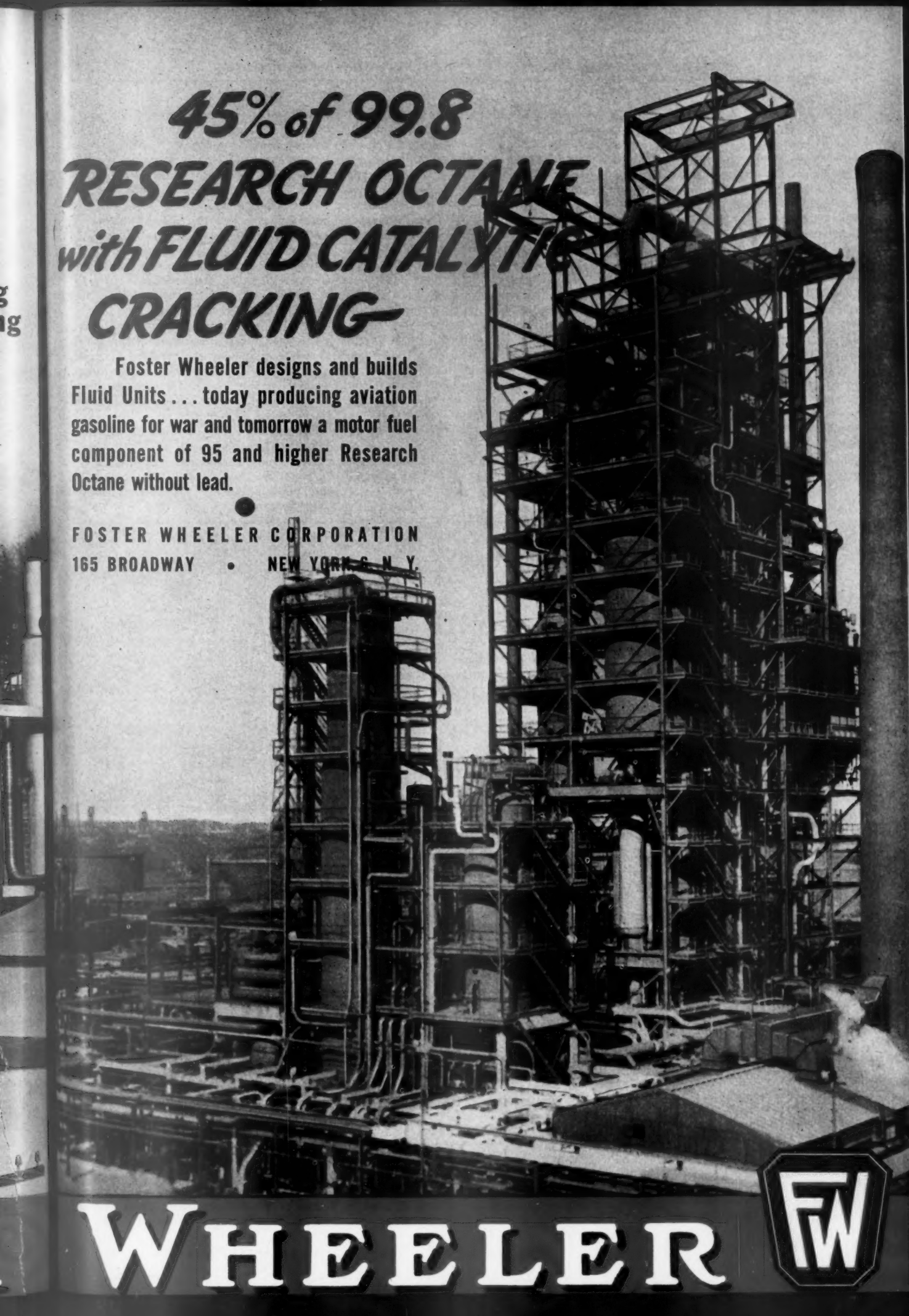
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say, they have not yet had to bring in any "outsiders" for this work.

The chief inspector has the responsibility of seeing that his men are trained and kept informed on new methods. There is no formal "course of instruction" used in training an inspector. The groups are small enough to permit individual instruction in the necessary duties and responsibilities. As a supplement, departmental roundtable discussions are held periodically.

Inspectors sit in on process-engineering group discussions regarding operation of new equipment or the new operation of old equipment. The preparation of isometric drawings of lines and equipment is considered one of the best ways for new inspectors to become familiar with operating equipment in preparation for inspection. These drawings then are used for recording locations of measurements taken in inspections and for reports.

Scope of Inspection

The inspection department concentrates its attention on physical conditions of stills and other mechanical equipment, operating and structural, in the refinery. Electrical equipment is not included, but is inspected by the electrical department personnel which has the required specialized knowledge and experience. Other equipment, such as steam boilers, required by law to be inspected by a government agency or some outside source, also is not included in the list of the inspector's responsibilities.

Frequency of inspection is governed solely by experience and judgment. When "new" equipment is installed, it is inspected at brief intervals until corrosion trends are established on which to base an inspection schedule. The designers of the equipment as well as others who have operated it elsewhere are consulted for this information. It is recognized that changes in operating conditions as well as charge stock usually alter corrosive conditions in any plant. When such changes occur, practice calls for increasing inspection frequencies until the new trend is established, if previous experience does not already cover the situation.

When the frequency of inspections is determined, an inspection schedule is set up which indicates the points where checkup is required and the frequency of inspection.

Records and Reports

Adequate records and reports are the heart of any efficient system. Phillips outlines its inspection system thus:

I. Records and Reports

a. Sufficiently extensive to show—

1. Trend of corrosion. 2. Extent of inspection. 3. Approximate period for next necessary inspection. 4. Some idea of life expectancy of the lines, equipment, or vessel.

b. Provide for comparison with previous conditions (some measurements taken periodically in same location).

c. Distribute records or reports to those interested so that—

1. Necessary replacement material may be ordered in advance. 2. Suggestions concerning operation to promote life of equipment may be offered if available. 3. Operating procedure may be altered where advisable to protect equipment from severe service or excessive corrosion.

d. Records shall be kept up-to-date and distributed as rapidly as possible after inspection is made.

e. Records shall contain—

1. Coke deposition for run. 2. Length of run. 3. Character of operation. 4. Present measurements. 5. Description of material of construction and original thickness of line or vessel. 6. Date of previous inspection and condition found if corrosion or conditions are exceptionally severe. 7. Replacements and alterations made with comments on what necessitated replacement, i. e., gradual loss of wall thickness, suddenly increased corrosion, change in operating conditions requiring equipment of greater strength, etc. 8. Description of flow changes made during shut-down. 9. Furnace flow sheet showing changes made in flow. 10. Isometric drawings showing lines described, their size and condition. 11. Simplified drawings of vessels showing points where measurements were taken. 12. Length of shutdown.

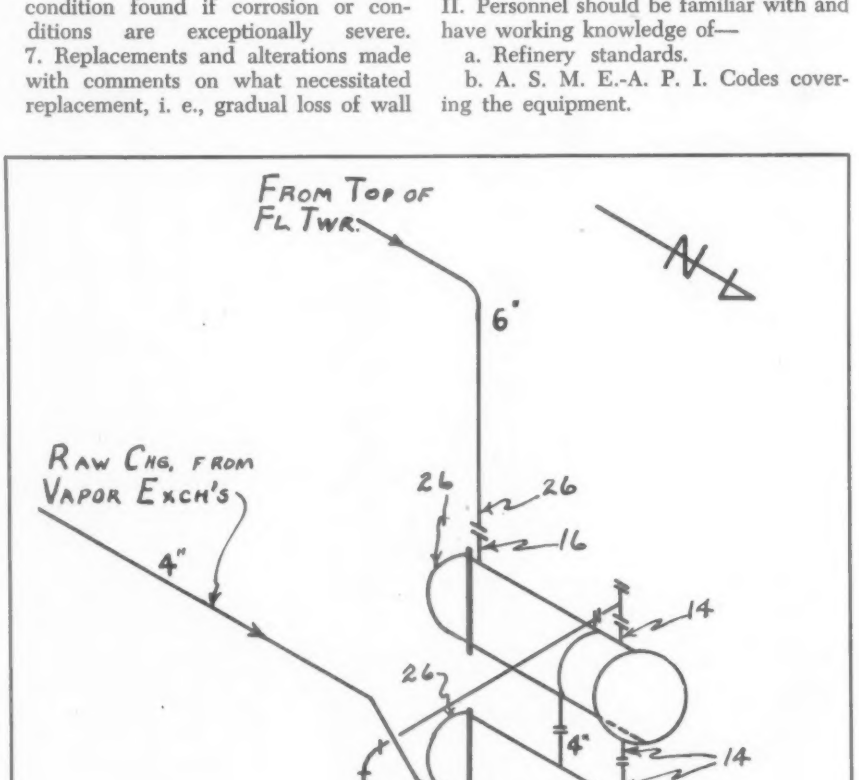
f. Information which should be available to the department—

1. Adequate flow sheets on units, to make inspection personnel familiar with equipment, terminology and use of unit. 2. Operating temperatures and pressures used on unit, to allow intelligent analysis of requirements for lines and equipment.

II. Personnel should be familiar with and have working knowledge of—

a. Refinery standards.

b. A. S. M. E.-A. P. I. Codes covering the equipment.



Isometric drawing used by inspectors at Phillips Petroleum Co. refineries, showing lines entering and leaving the gas-oil exchangers of a tube-still. Drawings such as this are used to record metal measurements, and in reports to management. Numbers indicate either size of pipe in inches or pipe thickness in 64ths of an inch. Similar drawings are used for other parts of a unit

c. Retiring thicknesses of lines and vessels.

d. Retiring thicknesses of furnace tubes and bends.

e. Proper procedures and methods for inspection.

III. Scope of Inspection—

a. Inspect operating units when they are down, to determine their condition and make recommendation for replacements and repairs necessary to preserve them in condition for desired operation.

b. Observe general operation of equipment and report to proper supervisor violations of safety limitations on pressure, temperature or speed.

c. Check salvage material such as valves, fittings, furnace tubes, pipe, etc., and make recommendations regarding limitations for their use.

Records are best based on isometric drawings of lines and on expanded drawings of the vessels themselves, in this company's experience. Individual drawings of equipment, such as are carried by inspectors in the field, are broken down into convenient size for handling. For a given unit, one will show transfer lines, another all lines entering the heater, others groups of exchangers, bubble towers, lines to pumps, and the like. Still others show the return bends in a heater, another each tube in the furnace and so on, all on a sufficiently large scale to permit individual tube-wall thickness measurements, for example, to be shown on the tube itself. Such drawings also are used in the final report which goes to the chief inspector, other interested parties in the refinery, and management.

An example of the isometric drawings used is shown for the lines entering and leaving gas-oil exchangers of a tube-still. It shows the size of pipe, each fitting and bend. Detailed drawings are used in the inspection of each of the exchangers shown. All drawings are duplicated on 8½ by 11 in. sheets from a master drawing. The illustration shows the points where the inspector examined lines serving these exchangers together with the measurements. Had replacements been made, they would have been indicated in red.

Data from the individual inspector's report also are transferred to a master record which shows in tabular form the original thickness of the part, calculated retirement thickness, date of original installation, date of every inspection and the metal thickness at this time. For convenience, each inspection point is given a number which coincides with the location shown by the inspector's drawing.

After the inspection is completed and the master record made, actual thickness at last inspection is noted and, as retirement thickness is approached, operations and maintenance both are advised to prepare for replacement of that part by a stated time. Using this plan, the part can either be ordered or fabricated well in advance of need and delivered (if it is bulky) to location. Otherwise, an emergency or unduly long shutdown might be necessary while the appropriate repairs are being made.

One great advantage in using drawings both to record measurements and to prevent "missing" a location where inspections should be made, is that the always onerous business of report-writing can be simplified. Long-winded explanations of where the inspection was made, what the measurement was and what was done about it are easily embodied in a single drawing, which is filed for future reference.

Methods of Inspection

While there generally are three methods of inspecting refinery equipment, Phillips places most dependence on visual examination and calipering. Hammering, while practiced, is used as a gross indication of thin spots rather than the final determinant. Both of these methods are so generally well-known as to require no further discussion.

The use of "tell-tale holes" is quite widely practiced in this company's plants at points where corrosion rates are high. For those who are not familiar with it, briefly it is the practice of pre-determining the minimum allowable metal thickness for the pressure and temperature of the service, then drilling a hole to that depth. The hole is small, and made with a very sharp-pointed drill. When metal loss due to corrosion reaches the bottom of the hole a small leak occurs, indicating necessity for replacement at the earliest possible date. Special clamps are fabricated and on hand for plugging these small holes until convenient to shut down the equipment.

To expedite inspection, prior to a shutdown the inspector or his supervisor places small metal tags, each bearing a number, at various points on the unit. These signify to the maintenance department that the line or vessel is to be broken at that point for inspection, whether or not it is a routine inspection point. These tags indicate to the inspector that a special check is desired at that point. Tags also serve as a check on the inspector, who must report a measurement for every tag; tags also may be placed by the chief inspector to see if the field man is doing a good job of inspection.

Considerable emphasis is placed on the thorough inspection of tubes, which are the items in a thermal cracking unit most frequently replaced. Despite their length, and the difficulty of access, tubes are calipered inside over their entire length. To do this, special calipers have been made which operate on the expanding-cone principle. In effect, two diametrically opposed pins ride on a cone attached to a rod. At the largest diameter of the cone, the pins are extended to maximum, and at the smallest diameter of the cone, pins are retracted to minimum. The rod is marked to indicate the diameter subtended by the two pins. Fitted with extension handles, the caliper will measure diameters for one-half the tube-length. By sliding the caliper over the inside of the tube, cuts and gouges left by careless cleaning as well as pits and bulges from corrosion and pressure can be detected. Calipering of the outside of the tube at selected points, augmented by visual observation, completes the inspection.

Auxiliary equipmenet to a unit, such as safety and relief valves, pumps and instruments are not precision-inspected by the plant inspectors. All except instruments, which are the care of a special department, are the primary concern of maintenance. Pumps are checked by the inspector during a run to see that they are not being operated in any hazardous way, and the cases are checked for thickness during shutdowns when the cases are open. Also, of course, the inspector must certify that the size, type and construction of pumps are proper for the service.

Valves are inspected similarly to pumps. Bodies are examined for thin spots and thickness is measured periodically. Valve efficiency is determined by the maintenance crew. The inspector must, however, rate all valves going into service for the proper application, whether they are new or reconditioned. This is indicated by painting the valves in different colors.

When lines, tubes and flanges are replaced, the inspector must certify that the proper material is used in the appropriate thickness for the contemplated service.

All safety and relief valves are tagged with the date set and the setting before they are installed by the mechanical department. A definite schedule of valve inspection is prescribed by the inspector for the mechanical department to follow. During the examination of a unit, he will see that valves indicate the proper setting required for the vessel on which they are installed, and that they are trimmed as specified. Occasionally he may pop them.

Tanks are inspected whenever they are cleaned. Where visual examination indicates the effects of corrosion, metal thickness at that point is determined, to be checked later against the service requirements for possible condemnation.

All vessels in the plant except boiler, etc., are pressure-tested approximately once annually. Usually a hydrostatic test is used at 1½ times working pressure. Examination follows the rules of A.P.I.-A.S.M.E. codes for the vessel under test.

An important part of the inspector's duties is to make recommendations for prolonging the life of equipment, or for its more efficient operation. From studying his records and reports, the advisability of substituting a different alloy can frequently be demonstrated, or equipment may be rearranged to facilitate repairs or accessibility. His suggestions may be of value in designing or redesigning equipment as in the case cited earlier on alkylation equipment.

Preventive Maintenance Reduces Repairs and Premature Shutdowns

*By H. J. Showalter**

The organization of the preventive maintenance program at a large refinery is described. The importance is emphasized of basing inspection schedules and of forecasting repairs on the actual operating conditions of the individual unit or piece of equipment. Cases of failure are examined and tested to determine causes and find means to overcome them. New materials are continuously tested to determine their possible advantages over those in use. The entire operating personnel is given training in preventive maintenance.

THE APPLICATION of "preventive maintenance" to all phases of refinery equipment has been found by experience to pay dividends in the successful and economical operation of a petroleum refinery. By preventive maintenance we mean the predetermination of possible life of equipment and the taking of necessary measures to prevent premature shutdown of units. This results in increased length of runs, shorter down periods, and provides the greatest degree of safety to personnel.

Preventive maintenance was inaugurated at the Port Arthur plant many years ago by the organization of an Inspection Department. This department developed along with the refinery. As refining became a more exact processing industry with larger, more complicated units using special equipment, the forecasting of repairs became of increased importance. Measures had to be taken to assure that plant equipment would operate safely and have satisfactory length runs and rapid return to operation, after it had been down. At present our arrangements to apply this condition of preventive maintenance can be broadly outlined as follows:

1—Arrange and schedule all units and certain plant equipment for inspection and test at regular periods.

2—Arrange to check specific equipment and maintain adequate records.

3—Set up an organization to determine the cause of all failures and develop preventive measures.

4—Arrange for the instruction of the refinery personnel in preventive maintenance.

Inspection and Test Schedules

In the refinery, due to the size and number of the various types of units, it has been found advisable to schedule down periods on all units at regular intervals, as the best means to have the required forces available to handle maintenance work, and for safety inspection. An inspection and test schedule is prepared 6 months in advance based on previous down periods. This schedule lists: last time down, the expected or next scheduled time down, and approximate length of the down period.

This original schedule is approved by the management. All operating units that require extensions of time from this scheduled date must be approved by the management. Our experience with the operation of various type units is the basis for determining the interval for this inspection and test period, or turnaround. Scheduling is so arranged that interconnected units are brought down in a manner best suited to maintain operation without seriously affecting production. Units have been classified as to type of operation to permit proper scheduling.

High Pressure - High Temperature

Units falling in this class are thermal cracking batteries, reforming, polymerization, and pressure coking units. On this type of unit a rigid rule is maintained that each unit must be shut down on, or before, a 6-month period has elapsed since completion of the last turnaround. Failures of equipment on units of this type are hazardous, and measures must be taken to insure that danger does not exist. At down period for cleaning, decoking of heaters, and so on, an inspector checks the unit for possible sources of trouble and pays particular attention to such locations as had been noted for observation from previous inspections.

Medium Pressure Light Hydrocarbon

Units of this type are alkylation absorbers, strippers, debutanizers and stabilizers. The practice is to require a complete turnaround period annually, and experience has proven that in the course of normal operation at least one shutdown of the unit is necessary, approximately within a two-month period of the semi-annual date, for cleaning and general repair work. At this time arrangements are made for a visual check of conditions. The units vary as to the corrosive nature of the charge stocks and special treatment in processing so that each type of unit is considered individually. This knowledge is of material assistance in keeping the cost of inspection to a minimum.

Crude Tube Distillation

This type of unit with atmospheric and vacuum section is represented by varied named units, all of which are predominately the same in nature of operations. They are inspected on a semi-annual basis, but not for such rigid requirements as to length of run as the high pressure, high temperature stilling equipment.

Shell Stills

Units of this type with a firebox under each still are in service in most of the older refineries, including crude, lube and rerun units. When stills are kept under observation for localized hot spots during firing the danger of a sudden failure which may endanger other equipment can be reduced. Arrangements are made for an annual test and inspection of units with a scheduled 6-month shutdown between these tests that normally coincides with a cleaning period.

Lube Oil Units

Units processing lubricating oils normally operate with little or no corrosion. The mechanical equipment is maintained by switching to spares, so that operation can be continued. These units are scheduled for intervals of inspection periods of one year to 18 months depending on operating conditions, with shutdowns at 6 months for relief valve checking and general reparis.

Miscellaneous

In all refineries there is considerable equipment not directly associated with operating units, where scheduling for regular checking and maintenance work is of advantage. A brief check of some items will indicate how this equipment is handled.

Tanks

An overall tank inspection is made every 6 months. Tanks are classified as to condition of shell, bottom, roof and paint, with the date shown when the deteriorated condition was first noted. Where tanks are classified as "poor", arrangements are made to give them a complete internal and external inspection by boiler shop inspectors and recommendations are made for repairs. Tank fittings require special attention, due to danger of the tank rupturing from internal or external pressure. Our tank fitting crews inspect all tanks each month and tanks in corrosive service are checked every two weeks.

Agitators

Equipment in the treating area is checked annually by personnel experienced in conditions and expected service life. The use of specially trained personnel is of paramount importance in

*Assistant Inspection Engineer, The Texas Co., Port Arthur, Texas.

determining whether equipment can remain in service or whether it should be discontinued and arrangements made for repairs or replacements.

Miscellaneous Equipment

Plant boilers and electrical equipment, transformers, transmission lines, etc. are checked monthly. Some plant equipment is handled by writing letters of notification to parties in charge of particular equipment, informing them that such an item is due to be inspected. A complete list of such equipment would be long, but a brief list will indicate what is done:

Item	Type Test
Elevators	Quarterly
Shop cranes	Quarterly
Gasometers	Semi-Annually
Acid blow cases	Semi-Annually
Portable boiler	Annually
Air compressors	Annually
Steam jacketed vessels	Annually

Finally, to cover the plant completely, an annual check is made of buildings, railroads, plant roads, bridges, levees, stacks, etc., to insure that no unforeseen difficulties develop during the year.

Handling Specific Equipment

All refineries maintain rules or methods in regard to the care of various equipment on operating units. General books of instructions in regard to various classes of units have been prepared by The Texas Co. and are issued to individual plants. These instructions are used as a guide for preparing specific instructions for inspection and test of certain units. These instructions are prepared by personnel intimately familiar with the inspection work. Details of the manner of handling specific inspection items are extensive, and for brevity, only a few will be mentioned, as follows:

Fired Heaters

Several men are thoroughly trained in heater inspection. While in operation heaters are checked for bulged tubes or tubes with hot spots, and in addition the men check heaters when down for possible sources of trouble. A complete history record is kept of individual tubes and fittings in each heater as to time put in service, material and original wall thickness. Corrosion rates are checked each time a heater is inspected to determine a possible renewal date. Minimum thicknesses for tubes and fittings have been established, and when these are reached, replacement is required. When excessive corrosion rates are shown, a more corrosion resistant material is installed.

Relief or Safety Valves

Three-way cocks are used on these valves on major operating units to permit servicing during operation. All relief valves are required to be checked for relieving pressure at least semi-annually. On high pressure high temperature units this interval is considerably shorter. Where the relief valves are subject to corrosive fluids which in time effect their setting, safety discs are installed before the valve. Records are maintained on the relieving pressure of all valves and if a valve continues to release at a pressure higher than its setting, arrangements are made to correct the cause.

Controllers and Instruments

With these vital portions of operating units, our preventive measures are mainly due to the foresight of trained personnel. The plant is subdivided into small areas with instrument men assigned to each area. These men make continuous rounds of the operating units in their area and many times they can determine from the action of an instrument if it needs attention. On major units instrument men are assigned to all shifts and they continually check and make repairs. Controllers are given attention to prevent sticking and are removed and sent to the shop for overhauling as necessary. In some acid service, continuous flushing of instrument and leads is practiced to prevent corrosion.

Determining Causes

A Test and Records Department is maintained in which one of the main functions is to determine the rates of corrosion through use of test specimens and to make recommendations for material to be used at various locations in the refinery. Failures of equipment, either due to corrosion or physical damage, are investigated by trained personnel and the material is metallurgically examined to determine the cause. Material for sale on the open market is investigated for its possible advantages over what is used at present, as for example, corrosion resistant paints, gasket material, ceramics, etc.

These investigations are continually carried on and, in many cases, as problems arise previous work will have developed a solution. If not, research work is instigated to determine what recommendations should be made. The use of cathodic protection to pipelines, of a considerable number of types of protective liners in vessels and of corrosion inhibiting agents has been investigated. All of this work is primarily to be able to forestall repairs by foreseeing what materials and methods can be used to advantage.

Training Personnel

One of the most important features of preventive maintenance work is the training of operating personnel. Many oil refining companies realize the importance of this and are taking steps toward the instruction of their men in the details of the correct procedure in their daily work. Particular emphasis is placed on the results to be gained by recognizing signs of possible failure and the damage resulting when they are neglected. Classes are conducted in preventive maintenance training. The benefits to be gained by this method are so numerous and obvious that no attempt is made to mention them.

In conclusion, it is to be said that inspection schedules are of value only if based on adequate data that has been weighed in accordance with operating conditions. Nevertheless, regardless of the data on hand, every plant shutdown should be considered an opportunity to check specific equipment as to previous records and indicate when scheduled inspections should be made. A suitable organization must be established with facilities to examine, analyze and determine the correct preventive measures to be taken to terminate present failures. There should be continuous investigation of new and better materials. Lastly, great strides can be taken toward improving preventive maintenance by properly instructing refinery personnel in its application to plant equipment.

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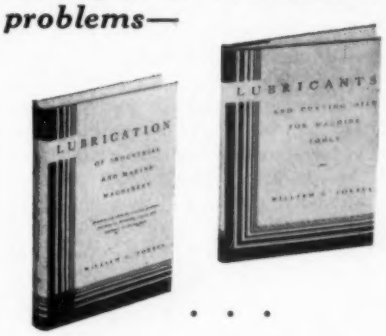

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PROCESSING WEST TEXAS SOUR CRUDES*

Methods Described as Used by Large Refinery for Desalting West Texas and Kansas-Healdton Crudes To Reduce Corrosion in Processing Operations

Part II

In the desalting operations on West Texas sour crudes as practiced at the Wood River refinery of Shell Oil Co., Inc., removal of about 85% of the salt is effected in established procedure. The same methods cannot be satisfactorily used with Kansas-Healdton crude, also processed at the plant, and new procedures are being tried. Justification for desalting is found in the reduction of corrosion and less frequent cleaning required for furnaces, heat exchangers and distillation equipment.

Part I, appearing in the Nov. 1 Technical Section of NPN, described the corrosion experience in a topping unit and thermal cracking unit at the Wood River refinery from the processing of West Texas sour crudes.

DESALTING operations at this refinery have been confined primarily to two crudes, West Texas and Kansas-Healdton. Operation on the former crude is consistently good and has been standardized, but the results obtained on Kansas-Healdton are not as satisfactory and the operating procedure is still undergoing development.

West Texas crude charged consists of a mixture of southwestern crude, of which the following composition is typical:

Crude	Vol.-%
Natural Gasoline	6.6
New Mexico	23.9
West Texas	63.2
North Texas	2.7
Wildcat Jim	3.6

The method of desalting consists of contacting the crude with water, followed by hot settling under pressure. Under the conditions employed, a salt removal of about 85% is regularly obtained, the salt content of the washed crude being about 10 pounds per thousand bbls.

Two 35,000 b/d three-column topping units are equipped with desalting facilities, which include the following items of equipment:

1. Three vertical salt settlers, each 10-ft x 40-ft equipped with an oil distributor spider and trylines. Each distributor is constructed of four parallel horizontal sections of 3-in. pipe connected to a 6-in. header, drilled with 1-in. holes on 1¾-in. centers looking up alternately to right and to left at an angle of 30 degrees from the vertical. Trylines are provided on each settler, located on 2½ to 3-ft. centers.
2. Water injection pump.
3. Caustic injection pump.
4. Brine recirculation pump (on one unit only).
5. Mixers for contacting the crude with water. Duriron, Hi-Hat, and globe valve mixers have been used.

The flow through the system is as follows: Crude oil is preheated in heat exchangers to a temperature of 220-240°F, after which water and caustic solution are injected into the crude stream ahead of the mixers. Following the mixers, the crude water emulsion enters the settlers through the distributor. (A brine level of 24-27 ft is maintained in the settler, so that the distributor is located 21-24 ft below the water-oil interface.) Desalted oil flows out the top of the settler, while brine is drained from the bottom of the vessel using a Hancock "Flo-Control" valve to control the brine-oil interface.

Factors Affecting Desalting

Salt is present in crude oils in two forms: (1) As brine droplets dispersed in the oil, and (2) as microscopic particles of solid salt. Both forms are frequently protected by a layer of wax or natural emulsifying agent in the crude. In order to remove the salt, it is necessary to mix intimately the crude oil with water, forming an emulsion, which then must be broken in the settling vessel. Several factors are of importance in the two operations and are considered below. It is emphasized that these results apply primarily to West Texas crude.

Approximately 30 psi pressure drop across the mixers appears to be optimum for maximum salt removal. Higher pressure drops result in the formation of more stable emulsions, which are difficult to break; lower pressure drops do not disperse the water injected sufficiently, and desalting efficiency is reduced. Normally the water injection rate amounts to about 2.5% by volume of the crude, although the actual value is dependent on the salt content of the crude and the brine concentration maintained.

Brine recirculation facilities were provided in the original installation (to permit recycling up to 20% by volume of brine), but have been found unnecessary. Actually somewhat higher salt removal efficiencies were obtained immediately after recirculation was discontinued, although this may be partially accounted for by an increase in the temperature in the salt settlers which occurred at the same time.

Injection of the emulsified water and oil into the aqueous phase has been found to be essential to good desalting. The position of the interface exerts a considerable influence on the results obtained, as indicated by the data shown in Table 6.

TABLE 6

Effect of Interface Location on Salt Removal

Height of Interface Above Oil Inlet—Ft	Salt Removal, %
2	35
5	85

Further development work indicated that most satisfactory operation resulted when the brine-oil interface is maintained about 20-25 ft above the oil injection point. This indicates that demulsification occurs largely during the passage of the oil droplets through the aqueous phase. The position of the brine-oil interface is considered to be that point where appreciable oil has started to separate. Actually, the crude at higher levels contains considerable quantities of water, as shown in Table 7. For the case shown, the interface is said to be 8 to 9 ft above the inlet.

TABLE 7

Water Gradient in Salt Settler

Distance Below Inlet—Ft	Distance Above Inlet—Ft	Water Vol —%
1.5		100
4		100
	1.5	
	4.0	95-98
	6.5	
	9.0	80
	11.5	70
	14.0	50
	16.5	35

Operating experience indicates that a brine concentration of 2.5-4.0 lbs. salt per bbl. of brine is desirable for maximum salt removal and minimum water consumption. This is shown by data in Table 8. The improved salt removal obtained may be attributed to two factors: (1) Stronger brines contain higher concentrations of those demulsifiers which occur naturally in the crude and which are extracted by the caustic soda injected into the crude and (2) A greater differential in specific gravities of the salt solution and the crude.

The pH of the brine should be maintained at a relatively high value (8.0 to 9.0 is about optimum) by the injection of 5° Be' caustic soda solution into

*Data and other material used in this article were taken from the report entitled "Processing of West Texas Sour Crudes at the Shell Wood River Refinery", by L. R. Gray, chief technologist of Shell Oil Co., Inc., and available through the company in booklet form.

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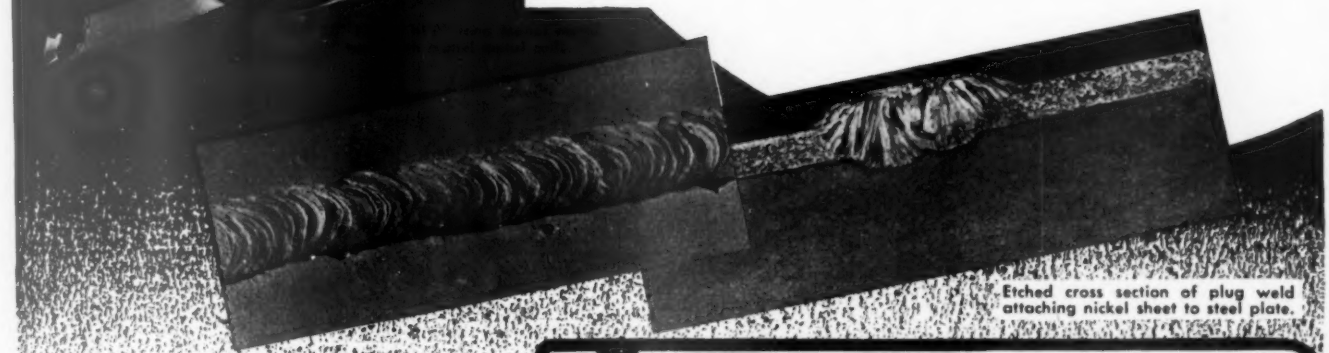

Etched cross section of plug weld attaching nickel sheet to steel plate.

Typical nickel weld.

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TABLE 8

Effect of Brine Concentration on Salt Removal

Salt Content of Brine Lb Salt/Bbl	Salt Content of Washed Crude Lb/M Barrels	Water Content of Washed Crude by Volume
.08	41	2.5
.11	25	0.7
.16	16	0.5
.19	15	0.5
.26	11	0.2
2.07	12	0.3
2.32	9	0.2
2.62	10	0.3
3.51	8	0.3
4.66	12	0.1
5.27	15	0.2
7.20	26	0.4

the crude stream ahead of the mixers. Caustic consumption is low (about .01 lb/bbl crude, or less) and the higher pH, in addition to improving salt removal, tends to reduce corrosion to the salt settlers. Partially spent soda from SR Naphtha Scrubbers (for removing H_2S) can be used without deleterious effect to desalting efficiency.

Temperatures of at least 200°F should be maintained in the salt settlers, and 250°F is highly desirable, since the higher temperature is of value in breaking emulsions. At present the settlers at this refinery operate in the range of 220-240°F. The pressure is not a vital consideration. It is only necessary that the pressure be maintained high enough to avoid appreciable vaporization. The operating pressure used at this refinery is about 150 psi.

High residence times are of value in obtaining maximum salt removal. The data included in Table 9 will illustrate this effect. It is recommended that the thruput be limited to 500 bbl per hour per settler for 10-ft x 40-ft settlers. Vessels of other sizes may be used, but the thruput should be limited in proportion to the available residence time for the oil. Vertical vessels of smaller diameter have not been used, and no data are available concerning their efficiency. With vessels of very small diameter, the vertical oil velocity may increase sufficiently to reduce appreciably the rate of settling of the water, and, consequently, salt removal.

TABLE 9

Effect of Residence Time on Salt Removal

Thruput Bbl/Hr/Settler	—Salt Contents - Lb/M Bbl— Crude Charge	Desalted Crude
510	59	6
600	59	16
675	59	23

Of course, other methods of coalescing the dispersed water have been proposed, among which are the following:

(1) Gentle Agitation. This is carried out by passing the oil-water emulsion through long pipes at relatively low velocity. The mixture is introduced into a settling vessel to permit separation of the two phases.

(2) Solid Contact. This method utilizes a vessel packed with Raschig rings, steel wool, glass wool, excelsior or similar material to coalesce the water. Final separation occurs in a settling vessel which follows.

(3) Centrifugal. The dispersed brine may be removed by centrifuging the crude oil.

The first of these methods is recommended by certain suppliers of proprietary treating agents and demulsifiers for salt removal. The second has been used successfully for coalescing water and treating agents in other products but experience with them in the desalting of crude is lacking.

Erratic operation in the past has been traced to an accumulation of solids (primarily sand and tank scale) at the water-oil interface, which stabilized the water-oil emulsion, resulting in high water entrainment, and poor salt removal. The difficulty can be eliminated by bypassing the settler and draining the interface material through the trylines.

The salt content of the washed crude is not appreciably affected by the salt content of the crude charged. Within the range of 50-100 lbs. of salt per thousand barrels of raw crude, the salt content of the washed crude remains constant at about 10-12 lb per thousand barrels. No difficulty has been experienced with oil entrainment in the brine drained from the salt settlers; the oil content of the brine is consistently in the range of .003 to .007% by volume. The brine is drained directly to the sewer without further treatment.

Table 10 is included to show typical operating data when desalting West Texas crude. These data are representatives of daily routine operating results at the present time.

Desalting Kansas-Healdton Crude

Experience has shown that Kansas-Healdton crude cannot be satisfactorily desalted using the procedure applied to West Texas. Mixing immediately preceding the salt settlers resulted in the formation of a relatively stable emulsion, with consequent high water carryover and poor salt removal.

Recently, favorable results have been obtained by recirculation of brine without fresh water injection (caustic is injected, of course, to maintain the pH). The brine is injected into the crude stream ahead of the five heat exchangers in series. The brine-oil mixture is gently agitated by the turbulence resulting from the passage through the heat exchangers, and no additional mixing is provided ahead of the settlers. Some water emulsified in the crude charge is removed and the salt content of the brine increases during the run. Since the topping unit is operated alternately on West Texas and Kansas-Healdton crudes, this procedure is feasible; the brine concentration is reduced to normal by water injection during West Texas runs.

TABLE 10

Typical Operating Data When Desalting West Texas Crude

Crude Intake—bbl/hr/settler	485
Height of Interface above Injection Pt.—Ft	21
Temp. at Inlet to Settler—°F	230
Water Injection—% by volume of Crude	2.5
Brine Circulation—% by volume of Crude	None
pH of Brine	8.5
Brine Concentration—lb salt/bbl	8.13
Settler Pressure—psig	160
Water Content of Crude—% by volume	0.1
Water Content of Washed Crude—% by volume	0.1
Salt Content of Crude—lb/M bbl	90
Salt Content of Washed Crude—lb/M bbl	10

Corrosion to the salt settlers is confined primarily to the bottom head and bottom shell region, where maximum rates of 11/64-in. per year and 7/64-in. per year have been experienced. The corrosion appears to be the result of oxygen attack, accelerated by sulfide in the presence of water. Oxygen enters dissolved in the water injected, while sulfide is due to H_2S present in the crude.

A ¾-in. ganister liner (Lumnite cement and ground brick ganister) has been installed in all salt settlers. Performance of the liner has been satisfactory. No deterioration of the cement has been observed in more than two years of service.

Analytical Methods

The water content in the crude oil is determined by the standard ASTM distillation procedure.

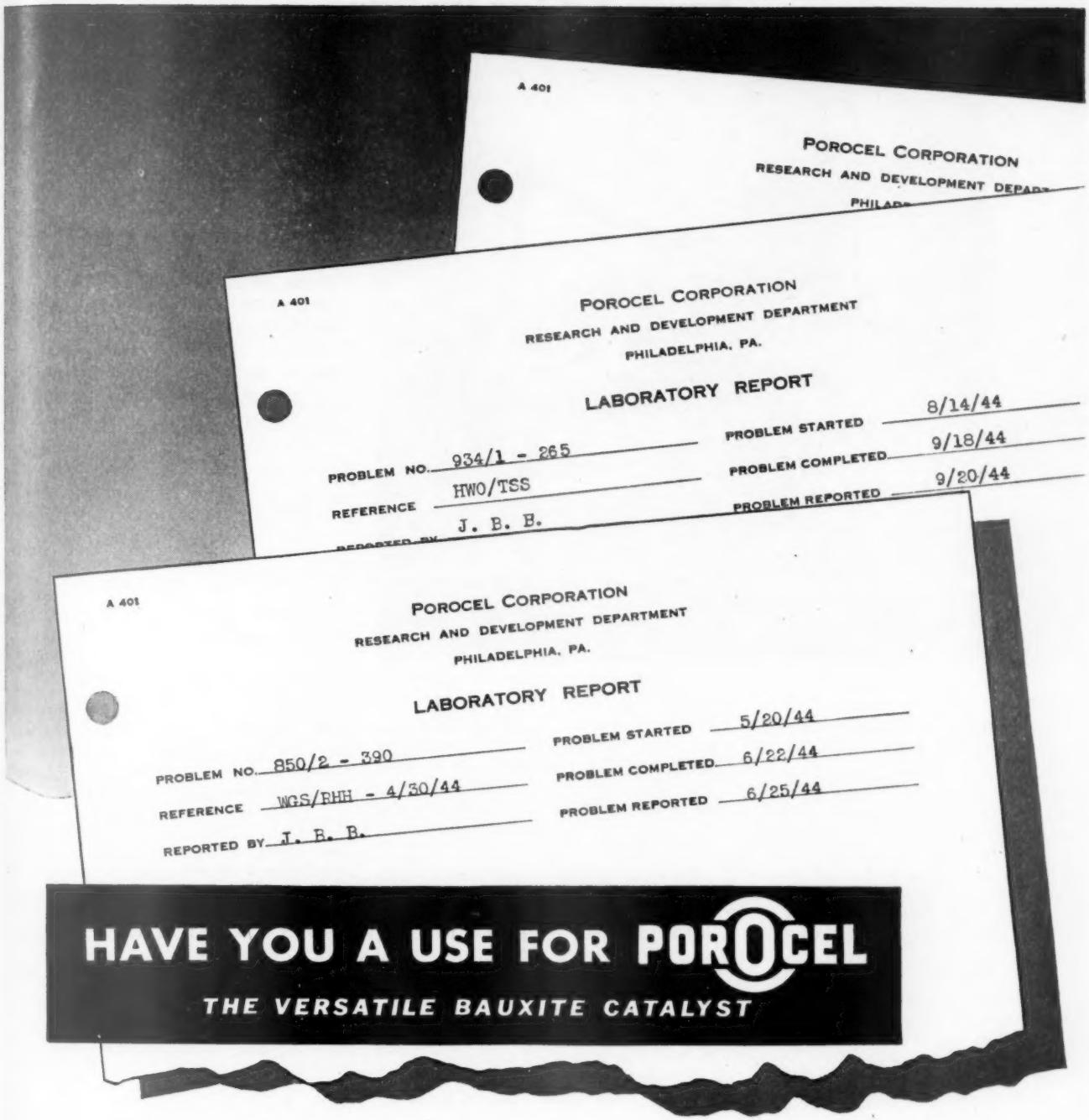
Salt in crude oil is determined as follows: To 200 cc of crude oil are added, in order, 30 cc alcohol, 30 cc acetone, 50 cc benzol, and 200 cc distilled water. The mixture is shaken after each addition, and 15-20 minutes after the water is added. Occasionally more benzol is required to break emulsions.

A 50 cc aliquot of the aqueous layer is titrated with standard silver nitrate (0.1N for high concentrations, 0.01N for low concentrations) using potassium chromate indicator. Results are reported by calculating the chloride so determined as pounds NaCl per thousand barrels crude. Note that in the calculations, allowance should be made for the alcohol and acetone, both of which are present in the aqueous layer.

Salt in brine is determined by direct titration of the brine with standard silver nitrate and potassium chromate indicator. Results are reported as pounds NaCl per barrel of brine.

Justification for Salt Removal

Justification for desalting can be summarized under two major groups: Reduction of corrosion, and reduction of cleaning of furnaces, heat exchangers and distillation equipment. Admittedly, the exact effects of desalting may vary widely in different refineries, depending on a large number of equipment design and operating factors. Nevertheless, these



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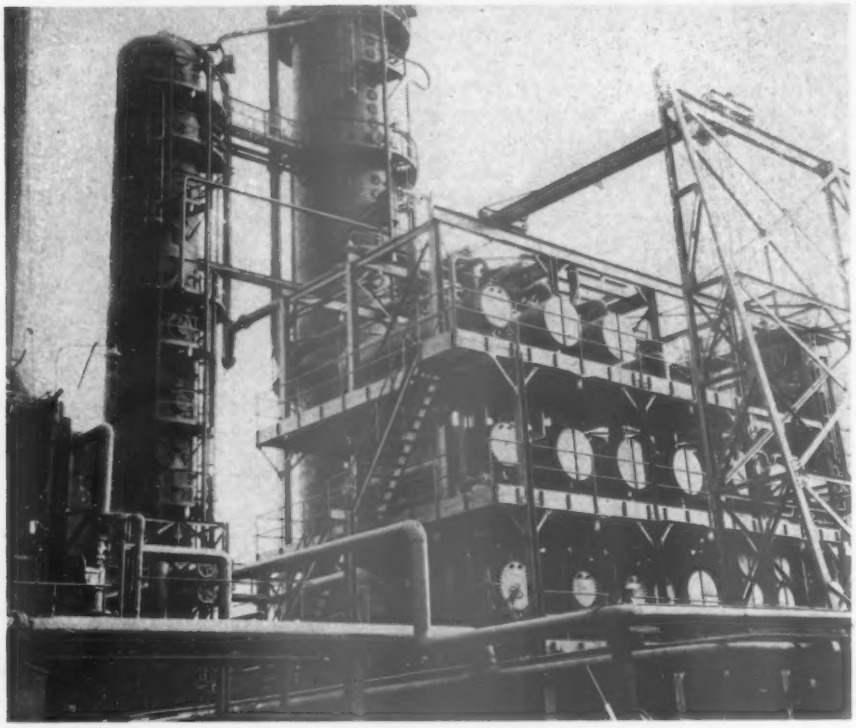

At the left are the towers of a topping unit at the Wood River refinery of Shell Oil Co., Inc.; heat exchangers, condensers and coolers are in the center; salt settler is at extreme right

results should be of advantage for a preliminary estimate of profitability.

Maintenance cleaning costs on heat exchangers are definitely reduced by salt removal. On topping units it was found that desalting reduced the cleaning cycle for the residue to crude heat exchangers from 4 to 8 weeks to 8 to 12 months. No advantage is gained in the other heat exchangers since these are used to preheat the crude prior to desalting.

Tube Deposition Also Reduced

A reduction in cracking tube deposition can also be claimed. No exact data are available, but indications are that a considerable portion of the tube deposit is salt. The effect is exaggerated when an alkaline agent is injected into the cracking unit charge to reduce corrosion. When using soda ash as a corrosion inhibitor (.5 lb. per bbl.) at a cracking plant, the heavy oil furnace run length was reduced from a normal of 60 to 70 days to 30 days as a result of soda ash injection. The salt content of the topped crude charged at the time of this test was about 100 lbs per thousand barrels of topped crude. The solids remaining in the tube after steam-air decoking were 80% water soluble, of which one-third was soda ash, and two-thirds salts normally found in crude oils (NaCl, $CaCl_2$, etc.). No data are available to indicate the effect of salt alone; however, when charging residues of much higher salt content, or when operating for runs longer than 60 days the effect may be appreciable.

Desalting crude oils reduces corrosion in both topping and cracking units. Not only are salt solutions corrosive to steel of themselves, but at elevated temperatures certain chlorides, principally magnesium chloride, hydrolyze, forming HCl, which is extremely corrosive, especially in condensers and other similar locations where it comes in contact with liquid water[1].

On topping units a reduction of heater tube corrosion of 27% was attributed to desalting. No data are available to indicate the effect on process lines and vessels; however, it is felt that desalting will be of some value here. It should be noted that these results are based on use of carbon steel pipe. Alloy piping is used at the topping units only to a limited degree, and no evaluation of its resistance to salt attack can be made.

On cracking units it has been found that desalting reduces corrosion of the heavy oil furnace tubes some 35%. This applies to the use of 5% chrome, .5% molybdenum tubes. Lime injection (.5 lb per bbl charge) was employed during the entire test period. Under the same conditions, a reduction of 23% was observed in coker furnace tube corrosion rates.

50% Less Tube Corrosion

Some data are available to indicate the effect of desalting on steel cracking tubes without lime injection. A 50% reduction was observed in this case following the inauguration of crude desalting. The data were obtained at different times, however, and should be used with some reservations, especially since the ratio of sweet to sour stocks in the residue charged to the cracking unit increased during the test period.

No information is available to show the effect of desalting on process line and vessel corrosion in cracking plants. Undoubtedly a reduction occurs but a quantitative evaluation of the advantages of desalting has not been possible. In addition, desalting of crude oils produces residual fuel oil of a lower B.S. &W. and ash content, asphalts of a higher CCl_4 and CS_2 solubility, and coke of lower ash content. Evaluation of these factors must, of course, be applied to each refinery separately.

[1] A summary of the corrosive action of salt, as well as desalting methods may be found in the Bureau of Mines Report R.I. 3422—"Desalting Crude Petroleum—A Review of the Literature").

CORRECTION

Inadvertently, several acknowledgments were omitted in the article "Azeotropic Distillation", by R. R. White, published in the Nov. 1st Technical Section, pps. R-731 through R-736.

The section "Application in Processing", pg. R-733, was written from material presented by E. G. Scheibel and E. Trueger at the May, 1944, meeting of the American Institute of Chemical Engineers, Cleveland. The section, "Extractive Distillation," pg. R-733, was written from material presented by M. Benedict at the June meeting of the American Association for the Advancement of Science.

The author wishes to apologize for these omissions.

Measurement of Residual Lubricating Oil Film Thicknesses on Vertical Metal Surfaces

By George L. Clark, Thomas D. Parks* and T. W. Culmer***

A simple technique is devised for measurement of the thickness of lubricating oil films on vertical metal surfaces, corresponding to cylinder walls and bearings in a motor, as a function of time of drainage, type of oil and polar additive, and kind of metal.

The purpose is to discover how much protection is available after such a motor has stood idle for hours or days. In all cases, the solvent extracted base oil diminishes continuously in thickness down probably to a monomolecular film, while oils containing commercial additives diminish in thickness to a value which remains nearly constant for several days, but is characteristic of each additive. For the base oil films are retained on different metal surfaces in decreasing order, steel, copper, aluminum, brass.

The radioactive indicator method is used as an independent check of the thickness measurements by evaluation of the screening afforded by films of varying thickness to a radioactive source in the metal surface, as measured by the Geiger-Mueller counter.

RENEWED interest has been demonstrated during the present war emergency in the protection afforded by lubricating oils in internal combustion engines, especially on airplanes and war equipment. In many instances, this equipment may stand idle for several days at a time. As a result, it is always questionable whether residual oil films remaining after drainage from the vertical walls are available for protective purposes, especially in the first few seconds or minutes after the motor is started following such a period of rest.

This paper presents the results of an investigation of methods of measuring oil film thickness on vertical metal surfaces as a function of time of drainage, temperature, type of metal and, of course, the oil itself as it is conditioned by the addition of polar compounds which serve as film strengtheners, antioxidants or agents which improve oiliness.

Parallel with this interest in additives has been that in methods of evaluating oil blends in order to predict properties and behavior on surfaces. The earliest and most familiar of these instruments is the Langmuir film balance which gives a measure of film strength from the collapsing point on the surface area curve. Similarly, the X-ray diffraction method was employed in this laboratory for the evaluation of structure and the study of built-up films by the Blodgett-Langmuir technique. These results clearly indicated how the polar additive molecules orient preferentially on metal surfaces and thus serve to stabilize the film of long chain hydrocarbon molecules and to anchor it effectively onto the metal surface.

Numerous attempts have been made to measure film structures and thicknesses by optical interference methods, but no success has been reported. The film balance and the X-ray methods have been valuable in leading to a fundamental understanding of the mechanism of additive action in lubricating oil films, but there are serious limitations in their use for practical and routine evaluations of residual oil films on vertical surfaces in the research laboratories of the petroleum industries. Therefore, the present simple technique was devised at the behest of the industries and government agencies in order to simulate operating conditions and to get an easily interpreted measurement of oil film protection in a motor over a period of time.

A solvent refined SAE 30 motor oil was used as base stock for all of the determinations. The oil was heated to 250°F. and maintained there. Into the oil were dipped strips of chrome-plated steel (1 in. x 3 in. x .005 in.). These strips were maintained at a constant depth for 5 seconds and were then withdrawn and allowed to drain in a dust free desiccator, being suspended in a vertical position. At definite time intervals, strips were taken out and the lower ¼-in. cut off with a pair of sharp shears, due to the fact that a globule of oil gathers here. The remaining film is not affected by that cut off. The area of surface covered on each strip was then carefully measured, using calipers; the strips were weighed on a semi-micro balance; and the oil was washed off with petroleum ether. The strips were then reweighed and from the loss in weight, specific gravity of the oil and the area covered, the average film thickness was calculated.

There are two or three possible sources of error in the procedure which should be emphasized. The temperature of dipping should be kept constant for the whole series, together with the length of dip. This is necessary because the heat build-up in the metal determines to some extent how long the oil on the surface is kept heated. With a higher temperature or longer dip, a thinner apparent film will result. Likewise, the drain temperature should be constant and this can be conveniently room temperature with no large fluctuations. One other thing to watch is to have sharp shears so that no error will be introduced in the cut-off operation.

This method has been used to evaluate the film forming tendency of an addition agent. A solvent refined SAE 30 lubricating oil was used as a stand-

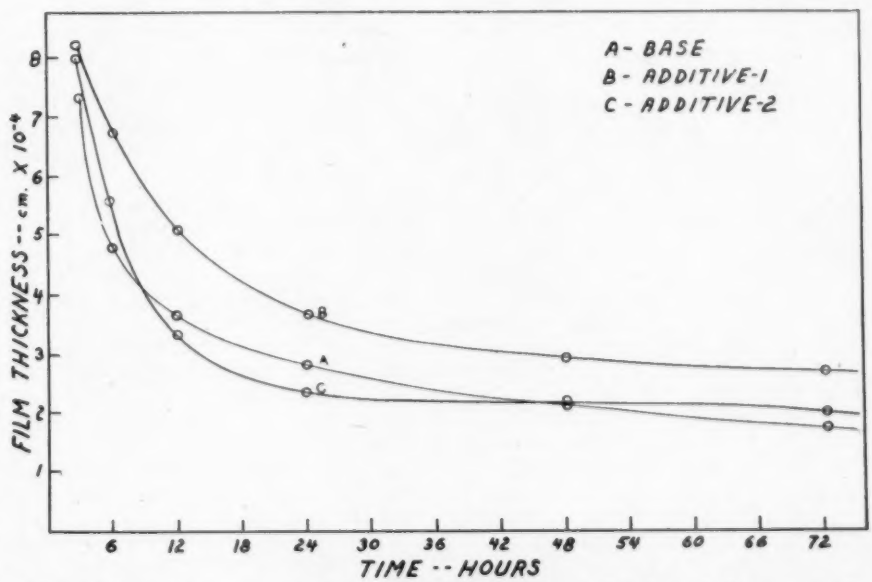

Fig. 1—Film thickness of a base oil, SAE 30 solvent refined, and the same oil with two different additives

*Noyes Chemical Laboratory, Department of Chemistry, University of Illinois.

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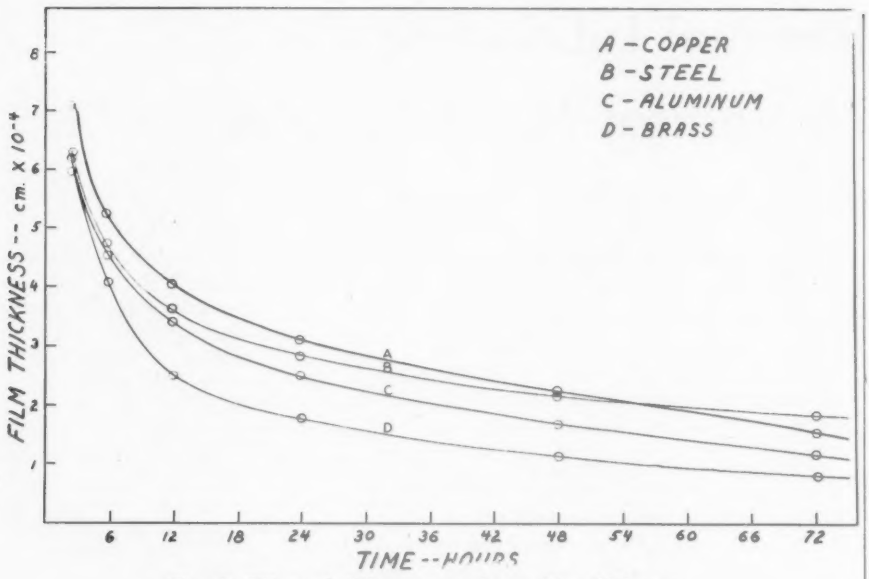

Fig. 2—Effect of different metals on film thickness

ard and the thickness of the residual film plotted against time. Commercial additives were then added to the same base oil and the results again plotted as shown in Fig. 1. The three types of curves are quite characteristic. The thickness of the base oil film (Curve A) diminishes rapidly and continuously to a boundary or nearly monomolecular film.

This same oil containing additive 2, curve C, diminishes even more rapidly for a few hours and then becomes constant for 72 hours and indeed almost indefinitely thereafter. Additive 1, Curve B, produces a film which diminishes more gradually and then becomes constant at appreciably greater thickness than the C oil. Thus this additive has the very valuable property of holding a protective film of adequate and constant thickness after drainage for several days Thus is obtained a quantitative measure of the ability of an additive to keep a protective film of oil on a vertical surface.

Another study involving this general method was carried out to find the effect of different metals on film thickness when no additives were used. This study was inspired by the knowledge that the occurrence of certain metals in bearings cause sludge formation and rapid deterioration. Metal strips of copper, brass (70-30), and aluminum were obtained of similar size to the chrome plated steel described earlier. These were buffed with a 4/0 emery wheel in order to standardize the surfaces. The results are shown in Fig. 2 and relate poor film strength of oils in the presence of certain metals to deterioration of oils with the same metals.

These curves show clearly, therefore, that both the oil and the metal surface are factors in behavior. Films are retained on chrome-plated steel and copper for a longer time and with greater thickness than on aluminum and brass. It is generally familiar that the latter two may be also the most active catalytically in aiding lubricating oil deterioration.

A related study to the above used the same metals and studied their effect in the presence of various addition agents. Some were found to give better film strengths in contact with one metal and worse with another. The value of this process lies in the wide possibilities of choosing a correct oil when the composition of bearings or engine parts are known.

Radioactive Tracer Method

Another powerful method which has suggested itself for the measurement of film thickness depends upon the screening power of oil films of definite thicknesses to radioactive emanations as measured with the Geiger-Mueller counter. This technique is a modification of that employed by Clark and Gallo on a radiosulfur tracer study of sulfurized lubrication addition agents (Jour. App. Phys., 14, 428 1943)). In this technique, metal discs which have been rendered radioactive by treatment with radioactive sulfur, as described in the prior paper, are then dipped in oil to produce oil films which drain from the vertical surface. The diminution of the number of counts on the Geiger-Mueller apparatus which results from the screening afforded by the oil film is then directly a function of the thickness of this film as it varies with time.

Only a few measurements have been made by this technique thus far, largely because the radiation is somewhat more penetrating than would be desirable for differentiation of thicknesses of very thin oil films. This, of course can be corrected by the use of a radioactive source on the metal surface with very low range and penetration. Preliminary results, however, have indicated complete agreement with the curves which have been obtained by the direct method described in this paper and thus afford an independent verification, both of the magnitude of the film thicknesses and of the variation with time depending upon the presence or absence of various types of polar additives.

Vapor recovery and fractionating plant in an East Coast refinery, designed and constructed by Petroleum Engineering, Inc. Offices: Tulsa and Houston.

Photographed for Petroleum Engineering, Inc.
By Robert Yarnall Richie

Practical Tests for Evaluating Lubricating Greases Described

By D. P. Thornton, Jr.
NPN Technical Section Staff

EMPHASIS on the practical in methods of evaluating lubricating greases was the technical theme of the meeting of the National Lubricating Grease Institute in Chicago Oct. 23-25. The need for widely usable tests, correlating well with field observations, was stressed in many of the papers and all bore in some manner on the subject.

Development of standard measurements, methods and specifications, as distinguished from those developed by individual companies for manufacturing control, were cited as prime points of consideration for grease manufacturers. By this means, they were told, they can avoid customer development of diversified tests, complicated and unwieldy specifications and the necessity of manufacturing many products for what will be essentially the same application.

Three of the 11 papers presented, besides the address of President W. H. Oldacre (D. A. Stuart Oil Co., Ltd., Chicago), which was non-technical in character, considered the development of practical evaluation tests for lubricating greases in service applications. Two more, concerned with evaluation of fundamental properties of greases, also considered this subject indirectly while still another showed that soap content and product structures, rather than pour test, control the low-temperature flow characteristics of soda-base greases.

First of the papers on practical tests for greases was presented by L. W. Sproule, Imperial Oil Co., Ltd., on "Some Methods Used in the Practical Evaluation of Lubricating Greases." This was a report of tests to evaluate greases from wheel bearing service, block-type, water-resistant and chassis lubricants.

In the first test, a front-wheel-and-spindle assembly from a 1938 Ford, driven by a motor, constituted the essential parts of the equipment. The bearings, weighed to 0.1 mg, were loaded with 5 g. of the particular grease under test. Run was continuous over a 6-day period, load on the bearing being 456 lb., and effect of the test being to simulate driving 10,000 miles at an average speed of 70 mph.

Thermocouples were installed to enable measurement of bearing temperature, and the loss of weight of bearing rollers and cup determined. Table I shows characteristic data from a series of test runs with different types of greases, conditions being selected to simulate severe operating conditions, but correlating well with field tests.

The second test was concerned with brick or block greases, tested in bronze bearings, each half-bearing being held by weights and a lever-arm against a steel journal 8 in. in diameter by 14 in. long, supported in anti-friction bearings. The temperature of the bearing (thermocouple) was recorded against simultaneous determinations of consumption in pounds per 100 hours and journal peripheral speed in feet per minute. Data from one of the tests reported show that consumption was relatively low as long as the bearing temperature was below 250°F. As the temperature went up, however, consumption increased rapidly until the grease melted and ran out of the bearing as the temperature reached 270-280°F—despite the fact that the dropping point was 376°F. In tests of this nature, consumption has been found to double for every 20° temperature rise in the range 200-250°F.

Water resistance was determined in the third test, which consisted of adding known amounts of water to the sample, while working for 10 minutes in an A.S.T.M. worker at constant temperature and 30 strokes per minute. One hundred grams of the grease were used, with water being added in increments of 20 g until particles were observed in the grease or it broke down into an emulsion. Least amount of absorption was taken as the water resistance.

The last evaluation test determined serviceability of chassis lubricants in spring shackles. A Chevrolet spring assembly was so mounted as to receive 60 shocks a minute; the shocks producing sidesway as well as deflection. Measurement consisted of determining the amount of grease lost from the shackle at regular intervals. Consumption may be correlated with the slope of shear curves developed from pressure viscometer data.

Anti-Friction Bearing Tests

Another paper on practical tests was "A Machine for Performance Tests of Anti-Friction Bearing Greases" presented by P. G. Exline in collaboration with S. A. Flesher, both of Gulf Research and Development Co., Pittsburgh. This paper described a machine capable of testing 4 grease samples simultaneously for its effectiveness in lubricating anti-friction bearings, making two to four simultaneous check runs on a single sample or two check runs on two samples simultaneously.

The third paper in this category was presented by J. R. Reynolds, U. S. Naval Gun Factory, and entitled "Naval Gun Factory Performance Grease Test." This report described a machine developed by N. G. F. for evaluating starting and running torque of greases in bearings used on electrically-powered Ordnance mounts with temperatures of 70°F and 0°F. The test is also used at 0°F to evaluate torque for greases saturated with water.

The machine consists of a small dynamometer housing, so constructed as to give a direct torque reading from the pressure of the housing arm on the scale. The driving shaft is direct-coupled to a 1 hp. 1750 rpm driving motor, with the shaft ends mounted in small pillow blocks and the housing supported on the shaft by the two standard test bearings (McGill No. 214, single

Technician P. G. Exline, Gulf Research and Development Co., Pittsburgh (left); N.L.G.I. director M. R. Bower, Standard Oil Co. of Ohio, Cleveland, and N.L.G.I. secretary E. V. Moncrief, Swan-Finch Oil Corp., New York, have an informal chat between technical sessions

TABLE 1—Data from Wheel Bearing Test on Three Lubricating Greases

	Grease Sample and Measurements		
Physical Description:	A*	B*	C*
Grease dropping point, °F.	195	400	363
SSU viscosity, mineral oil, 210°F.	46	190	60
Worked Penetration @ 77°F.	328	283	245
Wheel Bearing Test Data			
Maximum bearing temperature, °F.	214	181	132
Loss in weight of rollers, mg	252	9.0	Nil
Loss in weight of cups, mg	7.0	0.3	1.4

* A is a soda-lime soap; failed because high operating temperature of bearing melted grease out. B is a long-fiber soda grease; not satisfactory because the long-fiber caused it to be pulled out of bearing, thus giving poor lubrication. C is a short-fiber soda grease, gave excellent results.

TABLE 2—Naval Gun Factory Grease Torque Check Tests at 0°F.

	Original Tests		Check Tests		Deviation from Original Test	
Grease	Starting Torque lb. in.	Running Torque lb. in.	Starting Torque lb. in.	Running Torque lb. in.	Starting Torque %	Running Torque %
A	70.0	17.0	74.6	17.4	6.6	2.4
B	70.0	18.4	74.2	18.1	6.0	1.6
C	75+	17.6	75+	17.4	..	1.1
D*	34.7	12.2	31.8	12.0	8.3	1.6
E*	113.4	18.2	109.2	17.8	3.7	2.2
F**	41.2	11.0	48.0	13.2	16.5	20.0

* Check tests performed four months after original tests.
** Check tests performed two years after original tests.

row, 10 balls, bore size 2.7559 in. and 4.9213 in. O.D.).

Two test bearings, loaded full with the sample by using a pressure gun and modified Navy Grease Packer, are assembled in the housing, which has two arms measuring 10 in. from the center of the housing to the knife edge on the end. (This permits use of balancing weights to secure perfect balancing of the housing, and readings in .01 lb. increments up to 25 lb. are secured from pressure of one knife edge bearing directly on the platform scale.) Temperatures set for the test are based on actual Fleet experience, and are secured by placing the entire machine in the desired ambient temperature. Also, it has been determined experimentally that the greases tested will attain minimum running torque within 5 minutes after the test starts, so the standard running time for each test has been set at this value.

In further experimentation, it has been concluded that the torque obtained from the machine itself may be neglected. This was determined by running the machine for 5 minutes with completely cleaned bearings. Starting torque value of 1 lb.-in. and running values of from .5 to .8 lb. in. were obtained; greases meeting specifications must have not less than 10 lb.-in. starting torque at room temperature.

Table 2 showing check test results indicates the machine is capable of giving fairly reproducible results even when using different operators.

The paper commented on difficulties in correlating torque values by the N.G.F. machine and those by other methods, notably that specified in AN-G-3, Low Temperature Lubricating Grease. Several greases passing AN-G-3 at —67°F have failed to meet 0°F torque requirements under O.S. 1350, Bearing Grease for General Use in Naval Ordnance, when tested in the N.G.F. machine. This has been attributed to the slow speed attained on the AN-G-3 test device, while the N.G.F. machine is operated at 1750 rpm bearing speed.

First of the papers on fundamental characteristics of lubricating greases—considering viscosity—was that presented by E. W. Adams in collaboration with L. C. Brunstrum and E. E. Ziegler, all of the Research Department, Standard Oil Co. of Indiana, "Torque-Viscosity Characteristics of Lubricating Grease".

The other paper on viscosity was "Notes on the Operation and Application of the S.O.D. Pressure-Viscometer" by J. B. Patberg and J. C. Zimmer, Standard Oil Development Co. Largely dealing with techniques in operating the instrument under various corditions and experimental modifications, only that portion of the paper dealing with applications will be considered here.

The introduction to the applications portion of this paper states:

"The grease viscometer finds an important application in classifying lubricants for suitability to a given application, once service data have been made available. There are a great number of factors which affect the lubricating properties of a grease that are not revealed by the consistency tests now used for grease specification. While analysis of all these factors is extremely difficult, it is felt that the viscosity-shear diagram gives a sufficiently complete picture which is a composite of all of these factors. The general principle of all of the

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correlations is: two or more materials, which possess essentially the same viscosity-shear characteristics at a given temperature, will all perform a particular lubrication service with the same degree of efficiency. The following examples illustrate the general method of correlating viscosity with service data."

Of the examples given, one was to establish a manufacturers' control method for use in supplying a particular grease. Here, it was stated, stipulating the limiting apparent viscosities for three or four rates of shear and thus defining the entire viscosity-shear curve is all that is necessary; the limits being established on the basis of those materials which had proved satisfactory and unsatisfactory for the particular application. Also, viscosities should be determined at the temperature of application, with all control instruments (viscometers) of the same design.

In another example, a number of chassis lubricants were tested for consumption in the shackles of a Buick car equipped with coil spring suspensions, as well as in a simulated service test apparatus consisting of an actuated leaf-type spring and shackle assembly from a Chevrolet passenger car. These same greases were studied in the grease viscometer and the data plotted, rate of shear vs. shear stress. It was found that the slopes of curves thus obtained (mobility values) gave a linear correlation with the actual consumption and with that in the laboratory apparatus. This permits estimation of consumption of a given grease or the life of an actual lubrication test, once mobility has been determined by the viscometer. Other examples also were included of similar correlations, such as grease dispensing tests at low temperatures and starting and running torque specification data.

In still another paper relating to the flow of greases, "Effect of Mineral Oil Pour Point on the Flow Characteristics of Lubricating Greases", presented by C. W. Georgi, Enterprise Oil Co., in collaboration with J. F. O'Connell, Quaker State Oil Refining Corp., it was shown in an elaborate series of studies that the pour test of the oil—with or without pour depressants—had no appreciable effect on low-temperature flow characteristics of a soda-base grease.

On the other hand, the major factors influencing the flows of this type of grease at low temperatures were in order of importance: (1) the type of grease structure, (2) concentration of soap and (3) viscosity of the mineral oil. Of these factors, only viscosity is a fundamental characteristic of the grease, since structure of the grease is determined by the rate of cooling, amount of working before testing, etc. and the type and concentration of the soap also are directly controllable by the manufacturer. Viscosity, of course, is an expression of the force required to cause the material to flow, while the apparent viscosity is a function of the rate of shear or rate of flow. The S.O.D. Viscometer was used in these studies.

Grease Separation Studied

A paper, "Separability Characteristics of Greases" by T. G. Roehner and R. C. Robinson, Socony-Vacuum Oil Co., Inc., touches a trouble experienced by all greasemakers. However, an interesting fact brought out in the paper was that in the laboratory grease samples under 3000 psi showed no tendency to separate oil, yet in dispensing cups, under less than 10 psi and identical temperature, up to 20% of the oil separated from the samples.

Investigations gave rise to the conclusions that the separability of a grease was governed by (1) grease structure, that is, type of soap, additives present, presence of mutual solvents and manufacturing procedure; (2) the amount of soap in the grease; (3) viscosity of mineral oil used; (4) the time sample was under conditions enhancing separability; (5) the pressure on the sample, and (6) the design of the retaining agency—the cup, gun or central greasing system. All of these, plus the filtering action of the grease itself, are expressed in the separation of oil and soap under pressure.

Among other papers of interest were two on greases used by the metal industry; these included the development of lubrication systems for blast furnaces and lubrication problems in aluminum rolling mills. While actual specifications and test methods were not discussed, the factors of service application and problems encountered with the equipment were told. The two papers were "Centralized Lubrication for Blast Furnaces" by A. J. Jennings, The Farval Corp. and "Grease Lubrication of Aluminum Rolling Mills" by Dr. E. M. Kipp, Aluminum Co. of America.

Lieut. J. A. Christiansen, U. S. Navy Bureau of Ships, presented a paper entitled "Greases for the Bureau of Ships". This dealt largely with detail changes of specifications for Navy-purchased lubricants.

An interesting chairman's report, although sketchy as to detail in line with military security requirements, was that of W. G. Ainsley, Sinclair Refining Co., entitled "Report on the Activities of the Coordinating Research Council—War Advisory Committee — Grease Advisory Group." Membership of the group, which held 10 major meetings in the period covered by the report as military grease problems developed, includes E. W. Adams, Standard Oil Co. of Indiana; E. W. Aldrich, National Bureau of Standards; C. W. Georgi, Quaker State Refining Co.; Gus Kaufman, The Texas Co.; C. L. Knopf, Sinclair Refining Co.; L. M. Helman, Tidewater Associated Oil Co.; T. G. Roehner, Socony Vacuum Oil Co., and J. C. Zimmer, Standard Oil Development Co.

Some 35 projects have been submitted to the group, of which 15 were completed, one cancelled, two are awaiting preparation of final reports, and the balance, 17, still are under investigation.

Two N.L.G.I. directors talk it over after a technical session. Carl W. Georgi (right), Enterprise Oil Co., Buffalo, vice-president elect and technical committee chairman, explains a moot point to Sydney Bevin, Fiske Bros. Refining Co., Toledo

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Keeping Up With the News

*By N.P.N. Special Writer**

This series is intended to present a brief, technical-economic survey of some of the many new events in scientific and industrial circles which relate to the future of the petroleum industry.

Technologic advances and the necessity for serving on an ever-widening market have linked the petroleum industry with fields which were previously foreign to it. In this issue, therefore, it does not seem strange to find items on synthetic detergents and postwar aviation in addition to discussion of new developments related to synthetic liquid fuels, postwar refinery construction, and data on oil filter cartridges.

The author of this series is a chemical engineer in the research subsidiary of one of the larger oil companies. His duties include a continuous survey of the current technical journals in many fields related to the petroleum industry.

Postwar Aviation

THE petroleum industry, of course, is always interested in learning what the aviation industry thinks of its own future, since the production of aviation fuels in peacetime has proved a profitable endeavor and since the end of war will find aviation gasoline manufacturing facilities many times larger than prior to Pearl Harbor. For this reason, a voluminous and detailed survey entitled "Air Transportation in the Immediate Postwar Period,"[1] released by the Curtiss-Wright Corp., Airplane Division, is being perused by the industry with more than casual interest.

This survey predicts a gradual, then accelerating, decline in postwar air transportation rates, estimating that within five years after the war domestic passenger rates will average 3.5 cents per mile and domestic air cargo rates will approximate 30 cents per ton-mile. These figures compare, respectively, with prewar rates of 5.1 cents and 80 cents. At these lower rates, some 700,000,000 passenger-miles and 110,000,000 ton-miles (of cargo) are expected to be flown, as compared with 1940 figures of 104,000,000 passenger-miles and 3,500,000 ton-miles. In addition, Curtiss-Wright predicts that some 87,000,000 ton-miles of domestic airmail will be flown annually five years after the war (compared with 10,000,000 ton-miles in 1940). This is predicated upon the elimination of the surcharge for airmail services and the carrying of a tonnage, extrapolated from the 58,700,000 ton-miles of first-class mail carried more than 400 miles by the railroads in 1940.

Curtiss-Wright estimates that some 571 planes will be sufficient for these domestic purposes, compared with 338 planes in 1940. These 571 planes would have an equivalent seating capacity of 16,200, compared with 6200 in 1940. Curtiss-Wright states that this comparison is a more accurate indication of growth than that between the number of planes, since the size of the postwar planes will be considerably larger than those of prewar planes and the performance "will undoubtedly be much better, both because of improvements in equipment and operation."

In regard to postwar international air traffic, Curtiss-Wright believes that the share to be flown by U. S. carriers will be nearly 14 times greater than the 13,700,000 ton-miles flown in 1940 (including the equivalence of one ton-mile per 10 passenger-miles) and that some 158 planes with an equivalent seating capacity of 4900 will be required, compared with 125 planes of 2070 seating capacity in 1940. In addition, it is thought that some 725 planes with a total seat capacity of 10,600 will be required for the "foreign market"—airline operators conducting business under a foreign flag whose areas seem most accessible to U. S. manufacturers.

It might be noted, incidentally, that Curtiss-Wright included a pay-load factor of 65% in its calculations and that the company believes that medium-sized, trunk-line planes of 30- to 40-passenger capacity are best suited for the requirements of the bulk of the immediate postwar traffic. Planes of 150- to 200-passenger capacity are not expected to become a common sight for several years at least.

These figures and the many other predictions derived therefrom seem to bear out the statements of certain petroleum experts[2] who doubt if commercial aviation will require more than 25,000-50,000 b/d of domestic aviation gasoline five years after the war. This is a far cry from the 400,000-500,000 b/d now being manufactured for war purposes. Military and civilian consumption may raise the total demand to 100,000 b/d, but no very much higher figure may safely be expected.

Petroleum Soaps

A recent announcement in a British chemical journal[3] has served to call attention to the part which synthetic detergents, some of them derived from petroleum, are beginning to play. "Teepol," the detergent in question, is produced from a selected cut of C_{10}-C_{18} olefins prepared by cracking. These olefins are sulfated, carefully neutralized, and then purified, yielding sodium salts of higher secondary alkyl sulfates, excellent surface-active agents. The Shell group, responsible for the research which led to the commercial production of this product, are said to have constructed "a large plant" in England for its manufacture.

Synthetic detergents—"super-soaps"—have been coming in for considerable attention during the present war. Military washing—men and materiel—must be done in whatever water is available, soft, hard, or salt. Unlike soap (which itself is a detergent), most synthetic detergents are neutral materials, hence do not depend upon the "softness" of the water used for retention of cleaning properties; no "insoluble soaps" are formed in hard and salt waters. The Army, for example, figures on about 30 pounds of soap per soldier per year, and most of this soap contains varying amounts of synthetic detergents. One manufacturer of the "new Army All-Purpose Toilet Soap" states that his soap bars "contain approximately 25% synthetic detergent" and has printed on the wrapper of his "CQMG No. 100-A—Type II A" soap the following legend:

"This soap can be used in soft, hard, or sea water at any reasonable temperature for toilet use, shaving, laundering of clothes, and cleaning of mess-kits and similar equipment."

Petroleum hydrocarbon chains are not the only ones used in the synthesis of synthetic detergents; those of natural oils and fats are utilized for "a large proportion of these compounds." Nevertheless, petroleum-derived de-

[1] McDonald, B. A. and Drew, J. L., *Air Transportation in the Immediate Postwar Period*, Curtiss-Wright Corp., Airplane Division, Business Research Department (Buffalo), March, 1944.

[2] Anon., *NATIONAL PETROLEUM NEWS, Technical Section*, 36, No. 27, R-424 (1944), "Postwar Aviation."

[3] Anon., *Chemistry and Industry* 1944, No. 37, 327, "A New Synthetic Detergent from Petroleum."

tergents have been receiving a good share of attention, and one group of domestic products so derived—the Nacconols, produced by National Aniline—has been given considerable publicity. These particular detergents, alkyl aryl sulfonates produced from a kerosene cut, benzene, and sulfuric acid, are said to leave no ring around the bath tub, no waterline in the dishpan. Dinner plates washed in their solutions need no wiping; no invisible, insoluble film of hard-water soap dulls their surfaces. Nacconols may be used in dentrifices, to wash vegetables, and to clean cellars infested with insects or mildew. One of the most popular of bubble baths is made therefrom.

The general subject of detergents from petroleum has recently been covered in some detail.[4] The end of the war will see the mass reappearance on grocers' shelves of such household synthetic detergents as "Swirl" and "Vel," and a host of others may be expected to follow. It has been said that petroleum-derived detergents may, on a large scale, be produced as cheaply as soap. If this is true, some interesting developments may be anticipated.

Wartime Petroleum Supplies

WITH the end of the current war now apparently only a matter of time and the desperate efforts of millions of our soldiers, sailors, and airmen, there is a very natural tendency to forget that there may ever be another war, to resolve so firmly that international order *must* be established that the possibility that human nature will fail again is not carefully considered. It is unlikely that this country will ever again disarm as completely as it did after World War I, or that it will allow aggressor nations to arm themselves without at least taking adequate defensive measures, but it is not as certain that the problem of peacetime control of strategic material supplies is receiving the attention it deserves.

No member of the petroleum industry or the public at large needs to be reminded that this war has caused a domestic shortage of petroleum products. Fortunately, the supply of petroleum war products has proved neither "too little" nor "too late," but it has been a close squeeze and will so remain for the duration of the war. The civilian inconveniences caused by this overall shortage, however, have served to obscure some of the more dangerous potential aspects. Few people now give heed to what might have happened if there had not been enough gasoline for "essential" purposes. True, workers could have been compelled to live in temporary quarters at the scene of their work, as has been done in Axis countries; but our domestic economy would have been seriously disturbed and the war effort might have suffered accordingly.

The question of postwar petroleum resources is one which at present is the subject of violent debate, with geopolitical considerations at the heart of the differences. For the sake of argument, it might be conceded that *world* petroleum reserves are sufficient for generations if freely and equitably distributed ("equitably" possibly meaning that this nation will continue its high per capita consumption and other nations their low consumption). Present statistics and forecasts extrapolated therefrom, however, do not definitely show that *domestic* reserves will be able to take care even of domestic *peacetime* demands for any such indefinite period. The only alternatives are imports or substitutes. In a world at peace and free from unfair trade restrictions, the former is probably by far the preferable solution from the standpoint of economics, but if war should come again, and imports should again be rendered hazardous or impossible by means of enemy submarine or aerial activities, the latter would appear to be the solution.

An interesting commentary on these and related topics has recently appeared.[5] The Synthine (Fischer-Tropsch) process has been previously discussed in this series from several angles[6] and needs no elaboration here. On the subjects of petroleum reserves and synthetic fuel research, however, Ayres' remarks definitely add to the picture.

"The driving force behind all this work (on synthetic liquid fuels) is, of course, that our reserves of petroleum are not inexhaustible, and for reasons of national security we should not become dependent wholly upon imports. Oil for the duration of the next war must be in the U. S.—not somewhere else. Abundant oil somewhere else may be available only to our enemy. Postwar importation of oil, even if accelerated to the utmost by Government action, will neither save the major part of our domestic oil reserve for the next war, nor can it be depended upon to provide oil for the conduct of the next war except for the relatively small part of our imports which can be stored. The major load will have to be on petroleum products from our supplemental reserves, and this load cannot be carried by the commercialization of processes in time of emergency. The commercialization must be done in time of peace, leaving only expansion of going processes as a wartime activity."

Ayres has much more to say on the philosophy of national welfare and its relation to research, as exemplified by the Synthine process, and the tenor of his remarks is clear; serious attention must be given to the possibility of having to "oil" another war, and reliance cannot be placed upon the development of substitute fuels by industry alone or by government alone.

Oil Filter Cartridges

A recent paper[7] presented at the S.A.E. National West Coast Transportation and Maintenance Meeting is of interest to the petroleum industry in that it points out clearly that oil filters "cannot 'extend' oil life" and that for engine operations under certain conditions (such as low engine temperatures or with excessive blowby) they are "useless and unnecessary." These statements do not imply, however, that oil filters are not usually useful or necessary, and the paper describes in an interesting manner how cartridge diagnosis may be used to detect faulty engine conditions or filter neglect.

Bentley points out that oil used in internal combustion engines becomes contaminated: (1) from the engine with core sand, metal fillings, rust particles (iron, bearing metals), and coolant leakage (water and antifreeze); (2) from the air with dusts, dirt, sand, clay, coal soot, straw, and insects; (3) from the fuel soot, dilution (asphaltenes, resins, and oil acids), lead salts, and combustion products (water and mineral acids); and (4) from the oil itself with carbon, asphaltenes, resins, and oil acids.

A good oil cleanser, according to Bentley, must be inert to the oil and must not adversely affect any of its qualities. Adsorbent materials such as clays cannot be used, since they remove additives necessary for detergency and/or oxygen stability. The filter must be insoluble in the oil and contain no "treating" chemicals; "the problem of lubricating oil manufacture should be left to the oil refiner." Pure cotton is mentioned as a material which meets these specifications.

Other requirements for a good oil filter are mentioned, including sturdiness of construction, adequate capacity, and the ability to withstand high oil pressures and "to keep oil insoluble material from accumulating in the oil."

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[4] Wakeman, R. L. and Weil, B. H., *NATIONAL PETROLEUM NEWS, Technical Section*, 35, No. 14, R-161 (1943), "ABC of Chemical Derivatives from Petroleum. V. Detergents and Lubricants."

[5] Ayres, Eugene, *World Petroleum* 15, No. 11, 56 (1944), "The Synthine Process—A Composite of Research."

[6] Anon., *NATIONAL PETROLEUM NEWS, Technical Section*, 36, No. 27, R-421 (1944), "Natural Gas Resources"; No. 31, R-564 (1944), "Gasoline from Coal"; No. 36, R-585 (1944), "Diesel Fuels From the Synthine Process."

[7] Bentley, Cecil, *Commercial Car Journal* 68, No. 2, 38 (1944), "Oil Filter Cartridge Diagnosis."

Oil pressure drop must also be avoided.

Bentley states that "filters cannot 'extend' oil life. Oil life is a property of oil built into it by the oil refiner. It is dependent also on the service to which it is applied and the care given to it. The oil filter can maintain the oil in a condition whereby maximum oil life in service can result. There is no pat answer to the question 'when should oil be changed'? The engine operator working with his oil supplier can arrive at a schedule of operation best suited to his requirements."

Asphaltene formation and accumulation are termed "the bad oil apples" —likened to the few bad apples which spoil the barrel of good ones. Bentley states that a frequently-overlooked source of these asphaltenes is dilution by unburned, oxidized heavy ends of the fuel.

Oil filters are an established part of many of the present makes of cars, but their presence often causes a motorist to place undue confidence in the length of service permissible for his crankcase oil. Properly used, they definitely prolong the life of the engine, but improper use under improper conditions, it would seem, can do more harm than good.

Refinery Construction Program

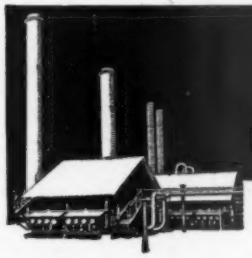
A recent issue of *Keeping Up With The News*[8] took occasion to mention PAW's invitation to refiners to submit detailed plans for refinery construction which will be needed when relaxation of controls over materials and labor becomes possible. No definite time for permitting this construction was promised, and it was stated that first consideration would be given to projects which lend themselves directly to support of the war program.

It is of interest, therefore, to survey recently-announced results of this invitation. Permission to construct $176,789,385 worth of domestic refinery equipment and $176,155,000 worth of foreign equipment (including five new refineries costing $146,000,000) was requested, and Deputy Petroleum Administrator Ralph K. Davies has announced that a letter covering the contemplated construction has been forwarded to WPB.

The tables appended to the release revealed that slightly more than 50% of the programmed expenditures for postwar domestic refinery construction are concerned with catalytic cracking equipment, testifying to the importance which plants of the various commercial types will have in the postwar picture and the pent-up demand for such equipment, wartime construction having left wide areas of the country "behind the times" and having permitted certain companies to "steal a march" on others whose refineries were not so located that new

[8] Anon., *NATIONAL PETROLEUM NEWS, Technical Section*, 36, No. 31, R-565 (1944), "Postwar Refinery Construction."

For ages the most important use of fire domestically, aside from heat, has been curing food. Industrially, fire has been the vital factor in securing the hundreds of products produced from petroleum. Skilfully combining research and engineering, Alcorn has met the ever changing techniques for heating hydrocarbons. Alcorn installations in major refineries throughout the world have set new standards for low cost operation and high production efficiency. Why not consider the merits of Alcorn's 20 years' experience for the solution of your heating problems?



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process equipment could give the maximum contribution to the war effort.

Lubricating oil facilities account for nearly 25% of the domestic program, also a significant fact. New processes have raised the standards for petroleum lubricants and have rendered economic the treatment of a wide variety of stocks, and every refiner is eager to keep abreast or ahead of his competitors.

While a monetary breakdown of the program is by no means as informative as one which would reveal planned capacities, the tabular data released are still of considerable interest, as given in Table 1.

TABLE I
(Domestic and Foreign)
Refinery Projects Planned

	Estimated Cost
Domestic	
Catalytic cracking	$ 90,775,000
Lubricants	42,869,928
Greases	3,524,170
Waxes	2,627,000
Crude topping, thermal cracking, and coking	10,612,875
Solvents and specialties	2,075,000
Alkylation, isomerization, and polymerization	7,348,000
Asphalt	1,765,000
Sulfuric acid	1,570,000
Treating	500,000
Utilities, services, etc.	9,272,412
Research and development	3,850,000
Total	$176,789,385
Foreign	
Five new refineries	$146,000,000
Additional facilities	30,155,000
Total	$176,155,000
Grand Total	$352,944,385

Among other facts, the comparatively minor interest in thermal cracking facilities stands out in contrast to the interest in new catalytic cracking equipment. Additional alkylation, isomerization, and polymerization equipment seem also to have been given only relatively minor attention.

Naturally, much more postwar refinery construction will be carried out than that programmed here, but the size of the program already planned is significant. Much equipment has been worn out at an accelerated rate because of operation under severe wartime conditions and at high rates. Other units have become obsolete by virtue of the rapid wartime progress in refining technology. Still other equipment is needed to produce higher yields of desired products from a given volume of crude oil or to make use of less desirable crudes for the same end.

WPB procedure will require approval of projects even after V-E Day, so, while no PAW commitments were made that permission to proceed would be given, the transmission of this program to WPB would seem to indicate that most of the projects listed will receive priority over similar ones requested later. The petroleum industry is certainly never a static one, and postwar refineries will continue to present new appearances as additional units are constructed.

'Synthetic' Natural Gas

THE recent completion of the 1265-mile pipeline of the Tennessee Gas & Transmission Co., linking southwest Texas with the Appalachian area, has been correctly heralded a godsend for the latter region, whose own depleted natural gas resources have proved insufficient to meet the demands placed upon them. The shipment of natural gas by pipeline to regions where it is needed and where it can compete profitably with other fuels has played a large part in industrial developments. Nevertheless, the clamor for this fuel foreshadows a coming bitter struggle participated in by local and state authorities in areas which now possess a surplus of resources (so large that much present production is wasted), yet who want to withhold these surpluses for future local use; Government agencies which desire to regulate interstate shipment in order to control uses; competing fuel interests fearful of the competition of "cheap" gas; and the natural gas industry itself, desirous of selling its gas wherever useable and profitable.

This struggle has barely begun, and so far economics alone have played the chief role in determining where and how natural gas shall be used, with legal restrictions confined to minimizing physical waste. Plans are even afoot to introduce high B.t.u. natural gas in regions now dependent upon manufactured gases. Conversion of the Big Inch and Little Inch petroleum pipelines to natural gas transportation has been the subject of detailed study, and it was rumored at a May meeting of members of the natural gas industry that investigations are in progress which look toward the shipment of liquefied natural gas to Eastern population centers by use of specially-designed tankers. Such a scheme, if economic—and it is said to have lower transportation costs, than the use of pipelines, might have the further advantage over pipelines of permitting a flexible supply, obviating large storage facilities to meet peak loads.

All of these plans and counterplans are of such importance that they have obscured a far-distant potential sidelight to the problem of future natural gas supplies.[9] The mechanics of "manufactured gas" production have long been studied, and coke-oven gas, water gas, carburetted water gas, producer gas, and other varieties are produced in huge volumes each year. Because of their lower B.t.u. content, however (155 B.t.u. per MCF for producer gas to 575 B.t.u. per MCF for a typical enriched water gas, as compared with 1110 B.t.u. for a typical natural gas), long-distance shipment of these gases by pipeline has not been economic nor have these gases been able to compete with natural gas in areas readily accessible to the latter. This has been true in the Appalachian area which, abundantly supplied with coal reserves, has found it usually cheaper first to use its own natural gas supplies and now to supplement these with natural gas imported from other regions.

As regards the future, however, potential developments in the Synthine process may change this picture. It has long been known that quantities of methane are produced along with the more-desired higher hydrocarbons; in fact, catalysts and operating conditions are carefully selected to minimize this tendency. At atmospheric pressure over a nickel catalyst, with carbon monoxide and hydrogen in a ratio of one to three, the methane-forming reaction goes practically to completion at 230-250°C. (446-482° F.), and much research on this reaction has been conducted in Europe and elsewhere, using gas mixtures in varying proportions and other catalysts and conditions.

Normal operation of the (German) Synthine process also produces some 8% of "Gasol" (C_3 and C_4 hydrocarbons), and it is likewise possible (but not usually desirable) to increase this proportion. In fact, one of the aims of the recently-announced Synthine research program of the Institute of Gas Technology is the discovery of processes that will yield "gaseous or readily-gasified products" which can be used for enrichment purposes.

If and when natural gas resources become exhausted, therefore, it would seem that modifications of the Synthine process may be ready to produce a "synthetic" natural gas or one of equal calorific value, far superior to the low-calorific water gas from which they are produced. It sounds very far-fetched at present, but some future generation might even see the Tennessee pipeline, or a successor, piping "synthetic" natural gas, produced from the abundant coal supplies of the Appalachian area, back to a Texas which has had its natural gas resources exhausted. This may never happen, of course, but it provides another example of the versatility of petroleum and natural gas research and of the Synthine process itself. Today, natural gas is being considered as the cheapest raw material for use in the Synthine process. Some far-distant tomorrow may see the process reversed and natural gas itself produced from a "synthesis gas" derived from coal.

[9] *NATIONAL PETROLEUM NEWS, Technical Section*, 36 No. 27, R-421, "Natural Gas Resources."

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WIDENING HORIZONS

Views on Personnel, Management and Economic as Well as Technological Developments in Petroleum Refining and Natural Gas Processing: Comment from Readers Is Invited

Applying New Refining Technology Is Individual Company Problem

IT WILL TAKE the oil companies some time to apply to the most economic advantage in their own operations the advances in refining technology which have been made in the wartime period. Under normal conditions these technological improvements would likely have been spread out over 15 or 20 years, or possibly longer. Under the urgency of wartime needs and through the pooling of development work by all the companies, the new processes and methods were developed and put in commercial utilization in a scant three years.

Their application to peacetime needs, however, must be worked out by the oil companies individually—and not only for reasons of legal necessity and because of the fact that the oil industry has always been notably a free enterprise. The problems in connection with postwar operations are individual to each company, with many factors involved that must be resolved to meet each company's particular requirements.

Some companies already are putting emphasis on economic studies in their consideration of the application of the new methods and processes. They are studying their natural markets not only for motor fuel but for other products as well. They are investigating the nature and extent of their future crude supplies, and planning to make the best possible use of any transportation and manufacturing advantages they may have. The refinery engineering firms also are preparing to advise oil companies on the economics of the new processes as well as on their technological features.

The greatest postwar potentialities for the refining companies are in the catalytic cracking processes. These processes in particular are being developed and engineered for applicability in small installations at about the same cost per barrel of capacity as for the 15,000-b/d and larger units built in the war program. Catalytic cracking plants represent the biggest single item in the postwar construction program of refining companies as reported to PAW.

In the wartime program around 900,000 barrels daily of catalytic cracking capacity have been installed in this country and about 100,000 barrels additional are planned. By the end of the war it is likely that the industry will have one million barrels daily capacity in catalytic cracking, as compared with two million barrels of thermal cracking capacity. This capacity, however, is now in about only 50 plants out of nearly 400 operating refineries in the country.

There are several general factors that will determine the volume of motor fuel which the cat-crackers will produce after the war. Among them are: The extent to which gas oil is economically available to these plants as charging stocks. Whether or not increased supplies of crude are available to the plants. The extent to which the catalytic units are operated on recycling and in hook-ups with other types of units to improve the quality of the motor fuel produced. The volume of aviation gasoline required after the war.

In addition, however, there are many factors which are individual to the single refinery and which management will have to evaluate—mainly on the basis of the economics involved. One of these is geographical location. About 60% of the wartime catalytic capacity has been installed in the East and Gulf Coast areas and about 20% on the West Coast, leaving only about 20% of the present plants in the interior refining districts where the largest number of small refineries is located. Regardless of what the nation-wide picture may be, it would seem that a study of the possibilities in catalytic cracking will be important for many of these refineries, especially where they are now disposing of their residual fuel oil at uneconomic prices. With catalytic cracking the refiner can eliminate entirely his production of residual fuel oils if he so desires and make more gasolines, distillates and other profitable products from his barrel of crude.

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THE circumstances at the individual plant will also make a difference in the kind and extent of use of the butane-butylene by-product hydrocarbons from catalytic cracking. Aside from alkylate for aviation gasoline they might be converted into motor polymer, or feed stock for butadiene. To a small extent they might be marketed as raw material for chemical manufacturing, with the balance selling as liquefied petroleum gas. Lacking other outlets they may have to be used as plant fuel.

While not so widely heralded a wartime development as catalytic cracking, technological improvements have also been made in late years in methods for the manufacture of high quality lubricating oils. Processes have been developed which enable the oil company to produce such lubricants from a greater variety of crudes, some of which have heretofore been thought to be unsuitable for the manufacture of satisfactory lubricants. Progress on a similar scale has also been made in the development of additives to improve the stability and other essential qualities of lubricating oils and greases.

Only a few lubricating oil plants have been included in the industry's wartime program and preliminary estimates indicate that consideration is being given to the installation of lubricating oil plants in postwar plans. The chief question for the individual oil company now is not whether the improved technology is available but whether the economic conditions which that company must face warrant expansion in this direction.

The wartime period has also seen the development of many specialized petroleum products, important in varied industrial uses although their total required volume is small. Industrial solvents and rust preventives are two examples of such developments. Some oil companies will find postwar markets for products of this type, which can be manufactured in their existing equipment or with small conversions, in their own marketing territories. While the volume is small, prices for these new products can be such as to make their manufacture profitable.

Closely related to the advances in refining technology are improvements in plant design and operating technique developed in the war period. Necessity forced these changes but some of them will become accepted procedure in postwar operations. For example, experience so far has indicated that thermal cracking plants can be operated at higher temperatures than was former practice, without undue damage to the equipment and with greater yields of butanes and butylenes. It may be economically profitable for some plants to normally run their thermal units under more severe conditions if the increased value of products more than compensates for tube replacement cost.

It is recognized that new inventions and operating techniques are likely to be brought forward at any time in an industry where large research staffs are maintained, such as in the oil industry. Barring such unforeseen developments, it would appear that the technologists have had their innings. They responded nobly in the war effort. The more direct need now is for the individual refining company to determine how it can utilize to its economic advantage the advances in technology that came about in the wartime period.

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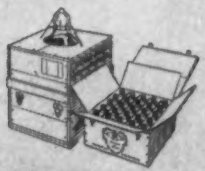

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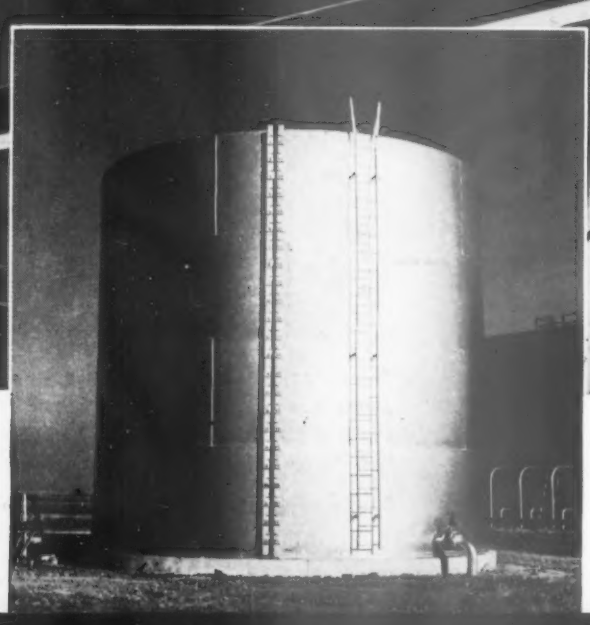

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